TRANSVAGINAL ULTRASONOGRAPHIC ASSESSMENT OF CERVICAL LENGTH IN PREDICTING PRETERM LABOUR IN HIGH RISK ASYMPTOMATIC WOMEN WITH SINGLETON GESTATION

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BONAFIDE CERTIFICATE

This is to certify that the dissertation entitled "**TRANSVAGINAL ULTRASONOGRAPHIC ASSESSMENT OF CERVICAL LENGTH IN PREDICTING PRETERM LABOUR IN HIGH RISK ASYMPTOMATIC WOMEN WITH SINGLETON GESTATION"** is a bonafide record work done by **Dr. N. PRASANNA** under our direct supervision and guidance, submitted to the Tamil Nadu Dr. M.G.R. Medical University in partial fulfillment of University regulation for **M.D Branch II – Obstetrics & Gynaecology**.

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I **Dr. N. PRASANNA** solemnly declare that the dissertation titled "**TRANSVAGINAL ULTRASONOGRAPHIC ASSESSMENT OF CERVICAL LENGTH IN PREDICTING PRETERM LABOUR IN HIGH RISK ASYMPTOMATIC WOMEN WITH SINGLETON GESTATION"** has been prepared by me. I also declare that this bonafide work or a part of this work was not submitted by me or any other for any award, degree, diploma to any other University board either in India or abroad.

This is submitted to The Tamilnadu Dr. M. G. R. Medical University, Chennai in partial fulfillment of the rules and regulation for the award of M.D degree **Branch – II (Obstetrics & Gynecology)** to be held in **April 2013**.

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INTRODUCTION

Preterm birth is defined as delivery before 37 completed weeks and after the period of viability [40]. Incidence of preterm birth ranges between 10 to 15%.

When babies born before 37 weeks are compared to term babies, morbidities which occur as a result of organ system immaturity are increased in infant born before 37 week gestation. These infants suffer from immediate complications of prematurity as well as long term sequelae such as neurodevelopmental disability. Preterm birth is imperative in its contribution to perinatal mortality. 75% of perinatal death occur in preterm infants and it becomes 85% after excluding lethal anomalies and here lies the importance of preterm birth.

"Sidney Miller is a child who was born at 23 weeks, weighed 615g and survived but developed severe mental and physical impairment at age 7 years, she was described as a child who could not talk, feed herself (or) sit up on her own, was legally blind, suffered from severe mental retardation, cerebral palsy, seizures and spastic quadriparesis in her limbs".[40]

This statement depicts the difficulties faced by a preterm infant, her family and society.

The process involved in initiation of preterm labour is difficult to decipher, but may result from an array of mechanisms initiating parturition at term. Besides, they may occur from uteroplacental insufficiency,cervical inflammation, mechanical factors, decidual haemorrhage ,cervical incompetence and so on. The factors which place a women at risk for preterm labour include demographic status, extremes of maternal age, low socioeconomic status, low prepregnancy weight, obstetric factors such as prior preterm birth, psychological factors, stress and so on.

Reduction in preterm delivery can be achieved only when there is a better screening test and availability of treatment strategies to defer preterm labour.Prediction is first step in preventing disease. Poor past reproductive performance to some extent guides in stratifying women at high risk for preterm labour. Methods available for prediction of preterm labour include risk scoring systems, biomarker assay which includes fetal fibronectin, salivary estriol, cervicovaginal β HCG, phosphorylated insulin like growth factor binding protein, cervical morphology, biometry. In preterm labour, cervical sonography to measure cervical length is one among the armamentarium of screening tools.

Screening test with high sensitivity and positive predictive value would ideally be useful in predicting preterm labour. Several randomized

controlled trials [2,24,28] suggest that effective screening by measuring cervical length at 23 weeks of gestation and therapeutic intervention with progestins upto 34 weeks could reduce risk of preterm delivery by 42% which would translate into improved perinatal outcome.

AIM AND OBJECTIVES

1. To determine cervical length by transvaginal ultrasonography in high risk asymptomatic women with singleton pregnancy.
2. To follow up these patients till delivery.
3. To correlate cervical length measured by transvaginal ultra sonography in these women with gestational age at delivery.

REVIEW OF LITERATURE

Cervix plays a dual role in pregnancy. It should remain closed during pregnancy to protect the fetus and at the same time should undergo effacement and dilatation during labour to allow passage of fetus.

Prompt recognition of cohort of women at high risk for preterm labour and delivery allows proper use of management aimed at prolonging pregnancy till fetal maturity is achieved.

ANATOMY OF CERVIX

Cervical portion of uterus is fusiform, open at each end by internal and external os. Internal os is upper boundary of cervical canal and corresponds to the level of peritoneal reflection on to bladder.Before child birth external os is a small regular circular or oval opening, which becomes a transverse slit with anterior and posterior lip after vaginal delivery.Portio supravaginalis is upper portion of cervix above vaginal attachment to cervix,portiovaginalis is lower portion of cervix below this attachment.[40]

Stratified squamous epithelium (non keratinized) lines ectocervix and mucin secreting columnar epithelium lines endocervix and has cleft like infoldings called glands. Mucus produced by endocervical epithelium

is altered during pregnancy, it becomes thick tenacious and plugs endocervical canal.

Cervical stroma has 10% of smooth muscle along with collagen, elastin, proteoglycans. Proteoglycans are glycoprotein present in increased amount, of which decorin and biglycan are responsible for organization of collagen fibrils. Structural disposition of cervix is mainly contributed to by collagen type I,II,IV. These collagen fibrils interact with small proteoglycans such as decorin and matricellular protein such as thrombospondin which accounts for regular and organized pattern of arrangement of collagen fibril in cervix.

During cervical ripening, there is a change in three dimensional structure of collagen fibrils and decreased expression of decorin, biglycan which results in disorganization, creating space between collagen fibrils.

Cervix has the following functions in pregnancy.

- Acts as a barrier to protect against infection
- Maintain cervical competence to protect fetus against gravitational forces
- Allows changes in extracellular matrix resulting in increased compliance in preparation for birth.

PRETERM LABOUR

Differentiation between true and false labour before occurrence of cervical effacement and dilatation will be difficult and misleading. Further presence of Braxton Hick contraction may also misguide diagnosis of preterm labour.The American College of Obstetricians and Gynaecologists together with American Academy of Paediatricians has putforth the following criteria to document preterm labour[40]

Contractions of four in 20 minutes or eight in 60 minutes with progressive changes in cervix.

Cervical dilatation greater than 1 cm.

Cervical effacement of 80% or more.

Symptoms such as heaviness in pelvis, lower abdominal pain, vaginal discharge which is increased in quantity and pressure over rectum are associated with preterm labour besides painful or painless uterine contractions.The significance of these symptoms as a prelude to preterm labour have been emphasized by many investigators.

Cervical dilatation:

Cervical dilatation without symptoms during later half of pregnancy was considered as a risk factor for preterm labour.

Cook and Ellwood evaluated cervix by transvaginal sonography in nulliparous and multiparous women between 18 and 30 weeks who had

term deliveries later and concluded cervical diameter was identical in both groups throughout the study period.

Cervical length:

Transvaginal sonographic estimation of cervical length in preterm labour prediction was evaluated extensively by many investigators which is detailed later.

BIOLOGY OF PRETERM LABOUR

Preterm labour may be acceleration of mechanisms involved in term labour. Romero et al proposed term labour is due to mechanisms which lead to physiological alterations in terminal pathway of parturition and preterm labour is abnormal activation of one or more of components of this pathway.[28]

Factors that maintain myometrial quiescence during pregnancy and factors which stimulate uterine contractions and cervical ripening has been to some extent elucidated.

Myometrium is composed of spindle shaped smooth muscle which communicate with each other through gap junction protein connexin.Connexin 43 and connexin 26 exhibit temporal relationship with onset of labour.Connexin 43 is low throughout pregnancy and increases before onset of labour.Connexin 26 is high during late pregnancy and falls to low level before labour. Hormones, prostaglandins

play a role in gap junction formation.Progesterone inhibit gap junction formation while estradiol stimulates their formation.

Cervical ripening implies increased softening, distensibility, effacement and dilatation as a result of change in collagen concentration, proteoglycan, glycosaminoglycan composition and increase in water content. (41)

Factors which control cervical ripening are as follows,

Prostaglandins, PGE2, PGI2 and to some extent PGF2 alpha are increased during cervical ripening. They act by collagen degradation and cause hydration of tissue by altering proteoglycan complex.

Progesterone inhibit collagenase activity in cervix and uterine corpus and is a physiological inhibitor of cervical ripening. Hence, progesterone withdrawal plays a role in initiation of labour. This is further supported by evidence that anti progesterone has softening effect on cervix by increasing prostaglandin synthesis and decreasing their degradation.

Relaxin increases collagenase activity and increased relaxin concentration in maternal circulation has been observed in preterm labour and act by altering connective tissue composition.

Further cervical ripening is a physiological inflammatory process. Pro inflammatory cytokines interleukin 1 beta, interleukin 6, interleukin 8

affect production of matrix metalloproteinase and tissue inhibitor of matrix metalloproteinases. They synergise with prostaglandin in cervical ripening.

L-arginine nitric oxide system in human cervix is upregulated during labour at term. Nitric oxide metabolites induce cervical ripening, prostaglandin production and matrix metalloproteinase release from cervical fibroblasts.

IMPACT OF PRETERM BIRTH ON THE NEONATE

Preterm delivery has short term, long term morbidity with financial implications. After exclusion of congenital anomalies and aneuploidy,preterm birth is an important cause of neonatal morbidity and mortality.Preterm infant has 30 fold increased risk of infant death in comparison to infant born at term.

Immediate consequences of prematurity include respiratory distress syndrome, intraventricular haemorrhage, sepsis, retinopathy of prematurity, necrotizing enterocolitis, infections from immature innate immune system, anemia, hyperbilirubinemia. Intraventricular haemorrhage especially in sub ependymal germinal matrix is one of the factors leading on to cerebral palsy, in addition to cerebral ischemia and infection.[10,19]

Long term sequelae include chronic lung disease, visual disturbances, cerebral palsy, mental retardation.Morbidity continues in adulthood where they face learning disability, behavioural problem and their consequences.Prematurity also extends it impact on family, society in terms of psychological, physical, financial aspect.

The reasons for preterm birth are as follows,

1. Spontaneous preterm labour without rupture of membranes.
2. Idiopathic preterm prelabour rupture of membranes.
3. When maternal, fetal indications necessitate induction of labour.
4. Twins and higher order multifetal birth.

Of preterm births, 30-35% are indicated, 40-45% are due to spontaneous preterm labour and 30-35% follow preterm premature rupture of membranes.[40]

Spontaneous preterm labour:

Preterm birth, upto 45% of cases – follow spontaneous labour. The pathogenesis of preterm labour was reviewed by Goldenberg et al and

has found progesterone withdrawal, oxytocin initiation, decidual activation as causative factor.

Preterm premature rupture of membranes:

Defined as rupture of membranes before labour and prior to 37 week, they arise from an array of pathological mechanisms, including intra amniotic infection and contribute to a proportion of preterm labour.

Medical and obstetric indications:

Antepartum haemorrhage, severe preeclampsia, eclampsia, fetal growth restriction, suspected fetal compromise are the most common indications for medical intervention resulting in preterm birth. Other less common causes are chronic hypertension, unexplained bleeding, Rh isoimmunisation, placenta previa, diabetes and congenital malformations.

The risk factors leading to preterm birth are as follows,

1.Threatened miscarriage:

Vaginal bleeding early in pregnancy has been implicated in adverse outcomes later. Pregnancy outcome in 14,000 women with vaginal bleeding at 6-13 weeks was investigated by Weiss & associates and this was found to be related to preterm labour, placental abruption, and pregnancy loss prior to 24 weeks. Threatened miscarriage places a

women at high risk for pregnancy related complications, antepartum haemorrhage, preterm delivery (relative risk- 3.6), PPROM, and delivery of small for gestational age infant [20,21].

Jemma et al [23] made a prospective cohort study of women presenting with first trimester bleeding and observed occurrence of preterm labour was doubled in women with threatened miscarriage.They are also at increased risk of preterm premature rupture of membranes and concluded women with threatened miscarriage have increased risk of preterm labour,which should be considered in antenatal surveillance of these women.(Level of evidence-II)

2.Life Style Factors:

Low maternal weight, Low BMI, and malnutrition are found to be associated with preterm birth. The relationship between maternal weight, BMI and preterm labour has revealed conflicting results. There seems to be association between low maternal weight (or) lack of proper weight gain during pregnancy and preterm delivery.[41]

Besides, few other factors implicated include extremes of maternal age, lack of prenatal care, short stature, ascorbic acid deficiency and other factors which are involved in work pattern such as lifting heavy weight, prolonged standing, stressful work, presence of deadline and so on (Casanova et al 2005)

Psychological factors such as depression, anxiety and chronic stress have been reported in association with preterm birth. [41]

Relative Risk.	
Age Less than 18 years	1.5-3.4
Age More than 35 years	1.3-1.5
Low BMI (less than 20)	1.5-1.8
Cigarette Smoking	1.3
Heavy Work	2.1-3.3
Stress	1.2-1.8
Substance abuse	2.5-6.0

This table depicts relative risk of various factors which predispose a women to preterm labour.

3. Maternal Reproductive History:

3a. Previous preterm delivery:

Major risk factor for preterm labour is prior preterm delivery (Sprong,2007). The following table shows incidence of recurrent preterm birth in 16,000 women, delivered at Parkland hospital.

Recurrent spontaneous preterm births according to prior outcome (Bloom and associates).[41]

Birth outcome	**Second birth < 34 weeks (percent)**
First Birth > 35 weeks	5
First Birth < 34 weeks	16
First and second Birth < 34 weeks	41

When a woman whose first child was born at term was compared to a woman whose first pregnancy resulted in preterm birth, the latter group had three times risk of repeat preterm birth .Approximately one third of women who had previous two preterm birth had next pregnancy ending in preterm birth. Mostly, 70% of preterm birth which recurred in this study was found to happen within 2 weeks of gestational age of prior

preterm birth, but they contributed to 10% of total preterm birth in this study.

3b. Previous abortion:

Preterm birth following spontaneous miscarriage (or) therapeutic termination of pregnancy, after controlling for confounding variables was evaluated in various studies. Risk increases with number of prior miscarriages (or) induced abortions, from 1.3 after one previous abortion to 1.9 after 2 (or) more abortions.

3c. Interpregnancy interval:

Short intervals between pregnancies have been associated with adverse prenatal outcome. In a recent meta analysis, Conde- Agudelo and Co workers (2006) reported that intervals shorter than one and a half years and longer than 5 years has been associated with increased risk for both premature and small for gestational age infants.[11]

4. Periodontal disease:

Vergnes and Sixou (2007) performed a meta analysis of 17 studies and concluded periodontal disease was significantly associated with preterm birth- odds ratio 2.83. (C.I.1.95-4.10). [12,37]

Michalowicz and associates (2006) found that treatment during pregnancy resulted in alleviation of the pathology yet there was no discernible change in rates of preterm birth.

5. Infections:

It is hypothesized preterm labour is triggered by activation of innate immune system due to intrauterine infections. Release of inflammatory cytokines by micro organisms such as Interleukins and Tumor necrosis factor triggers production of prostaglandin and enzymes which degrade matrix. Prostaglandin initiate and augment uterine contraction and degradation of matrix in fetal membranes results in preterm rupture of membranes. Intrauterine infections contributes to 25-40% of preterm labour.[40]

Ureaplasma urealyticum and mycoplasma hominis have emerged as important parental pathogens. Sonographically measured short cervix was associated with microbial invasion suggesting ascent from lower genital tract.

Several studies are done in which antimicrobial treatment was given to prevent preterm labour due to microbial invasion. Goldenberg and colleagues found antimicrobial treatment did not reduce rate of preterm birth nor that of histological chorioamnionitis.

Bacterial vaginosis:

Bacterial vaginosis has been associated with spontaneous abortion, preterm prelabour rupture of membranes, chorioaminionitis and amniotic fluid infection, preterm delivery.

Macones and colleagues[14] identified gene- environment interaction. When a women has bacterial vaginosis along with a TNF α genotype, which places her at increased risk of response, she accrues nine times increased risk of preterm birth.

Screening and treatment of bacterial vaginosis did not result in either reduction or prevention of preterm birth.[40]

Asymptomatic urinary infection has been encountered in pregnancy and has been related to preterm delivery. The accurate mechanism by which it results in preterm birth is masked, but there is evidence that there can be colonization of vagina with same pathogen as found in urine and bacteria may be regarded as a surrogate marker for abnormal vaginal flora which may be the cause for preterm delivery.

Shahira et al compared pregnancy outcome in women exposed and unexposed to urinary tract infection and found there was significantly high percentage of preterm delivery and small for gestational age infants among the women with urinary tract infection during pregnancy(relative risk 9.8 and 2.2). In antepartum urinary tract infection,bacterial products

phospholipase A,C endotoxin may simulate prostaglandin biosynthesis by fetal membrane initiating preterm labour.[36]

When viral infection of trophoblast is encountered, this may result in placental dysfunction leading to complications which range from spontaneous miscarriage, pre eclampsia to fetal growth restriction . Preterm birth (or) preterm labour may occur secondary to host inflammatory responses to viral infection.

Defects that result from mullerian duct development may result in miscarriage, ectopic pregnancy, rudimentary horn pregnancy, preterm delivery, fetal growth restriction.

Airoldi and associates[3] found midtrimester sonographic assessment of cervical length was reasonably accurate for predicting preterm birth in these women.

TESTS FOR PRETERM LABOUR PREDICTION

In an effort to provide a useful screening test for preterm delivery risk, several scoring systems have evolved that quantify epidemiological and pregnancy features, with digital assessment of cervix which include Creasy et al , Mercer et al , But these scoring systems lack features of effective screening test and hence are not used. [41]

1. Home Uterine activity monitoring:

Development of this ambulatory method (HUAM) of monitoring results in objective assessment of value of uterine activity measurement in prediction of preterm labour and delivery.[40]

Several Randomised trials evaluated use of HUAM in early prediction of preterm labour. US preventive task force does not support the use of HUAM and it is not effective as a screening test in high risk pregnancies. Threshold frequency of contractions which will be helpful for preterm labour prediction was not found by observational study conducted by Iams et al. [40]

2. Biochemical Markers:

Investigation of patho physiological mechanism underlying preterm labour has generated interest in identification and evaluation of biological markers as predictor of spontaneous preterm birth.

Fetal Fibronection (FFN):

FFN is a glycoprotein that acts as a cement or glue between fetal membranes and decidua. When normal interrelationship between chorioamnion and decidua is altered because of contractions or infection, FFN is released and appears in cervicovaginal secretions. [15]

FFN is normally present in cervicovaginal secretions before 22 weeks and after 37weeks.If FFN is less than 50ng/ml (negative result),

the woman is at low risk of preterm delivery. A negative FFN result has a high negative predictive valve and women with negative FFN have 97% probability that they will not deliver in 2-3 weeks. If FFN is positive, likelihood of preterm delivery is 35% in the following 2 weeks. Antepartum hemorrhage, ruptured membranes, speculum, digital pelvic examination, sexual intercourse, endovaginal ultrasound examination interfere with accuracy of test.

In most symptomatic patients in early preterm labour, sample for FFN is not appropriate in initial evaluation, if they have had examination or tests that invalidate results. In these cases it is necessary to wait for 24-48 hours, before test is performed.

Salivary estriol:

It reflects concentration of free unconjugated estriol in plasma. It is first detectable in maternal blood by 9 weeks and increases throughout pregnancy. Rapid surge in level precedes, onset of labour by 3-5 weeks. At a threshold of 2.3 ng/ ml, it has a sensitivity of 71% and false positive rate of 23% for delivery before 37 weeks. [32]

Corticotrophin releasing hormone.

It rises exponentially during second and third trimester .They are further elevated in women with preterm labour (Warren, et al).

Using cut off of 1.9 mom between 15-20 weeks, sensitivity and positive predictive value are 72.7% and 36% respectively indicating poor test performance. [41]

Relaxin:

It is a polypeptide produced by corpus luteum, placenta and decidua. Raised serum relaxin (more than 300 pg/ml) had moderate sensitivity, fairly high positive predictive value in preterm labour prediction.

Inflammatory cytokines:

Cytokines are released into cervicovaginal fluid during breakdown of choriodecidual adhesion or inflammatory reaction.Samira et al found there was 4.8 to 4.4 fold increase in cervical interleukin 6 and 8 level in early preterm labour compared to term delivery. [33,27,41]

Bastawissi et al evaluated role of amniotic fluid interleukin 6 in preterm labour prediction and found even when infection is absent, high interleukin level may culminate in preterm labour.

Elevated amniotic fluid concentrations of IL-6 was associated with preterm birth .Women with serum IL-6 level more than 8 pg/ml have shorter interval to delivery time. Women delivering before 32 weeks have elevated level of (G CSF) Granulocyte colony stimulating factor. (Goldenberg et al)

Urinary Matrix metalloproteinase – 9 greater than or equal to 5ng/ml was found in women progressing to preterm delivery (Agrez et al).

Phosphorylated insulin like growth factor binding protein-1

Decidual cells are the site of production of Phosphorylated IGFBP-1 and when there is separation of chorioamnion from decidual cell, as a result of uterine contraction, IGFBP-1 enters into cervical secretion. Less phosphorylated form of IGFBP-1 is present in amniotic fluid.Phosphorylated IGFBP-1 can be detected in cervicovaginal secretions by a specific monoclonal antibody. [24]

Leena et al found that Ph IGFBP-1 more than 10 ng/ml has 70% sensitivity and high negative predictive value in predicting preterm birth within 7 days of testing. Further it is not present in urine or seminal plasma, which adds to its validity.

MSAFP level more than 2.5 mom was asosicated with high risk of preterm birth.

Clinical utility of these biological markers are limited by current lack of availability or readily available assay. Further studies are required to determine whether they will be clinically useful in prediction of preterm labour.

Chan et al evaluated magnetic resonance imaging to assess relationship between gestational age at delivery, duration of pregnancy and cervical assessment and he found higher signal intensity was associated with short time interval to delivery.[41]

SCREENING METHODS FOR PREVENTION OF PRETERM BIRTH (ACOG GUIDELINES 2008). [40]

No current data supports use of home uterine monitoring (or) bacterial vaginosis screening.

Screening for risk of preterm labour, other than historical risk factor is not beneficial in general obstetric population.

Sonography to determine cervical length may be useful in determining women at risk of preterm labour. Their value rest primarily with their negative predictive value.

Methods to assess cervical length have gradually evolved over past decade.

"Transvaginal sonography is the preferred route for cervical assessment to identify women at increased risk of spontaneous preterm birth and should be offered to women at increased of preterm birth". (II- 2B Evidence level)

SOGC GUIDELINES MAY 2011.[9]

Iams et al, conducted a prospective multicenter study in which unselected general population of women with singleton pregnancy underwent TVS at 24 and 28 weeks gestation. Cervical length at both examination was comparable and normally distributed with a range from 26.9 to 43.5 mm at 24 weeks and from 25.2 to 42.2 mm at 28 weeks and correlation between cervical length and rate of spontaneous preterm birth was determined. [17]

If cervix was less than 26 mm (10^{th} centile) or less than 13 mm (1^{st} centile) risk of spontaneous preterm birth was increased by 6.49 fold and 13.99 fold respectively compared with rate of spontaneous preterm birth if cervix was at 75^{th} percentile length (40 mm) or greater. Based on this land mark study, the definition of short cervix as less than 25 mm (or) 10^{th} centile length at 24-28 weeks was accepted.

Since then more than 50 studies of TVS evaluation of cervix and rate of progression to spontaneous preterm births have been published.

Honest et al, conducted a meta analysis of 46 studies (>31,000 asymptomatic singleton patients) and concluded utility of TVS measurement of cervical length for prediction of spontaneous preterm birth varies with gestational age at which cervical length was assessed and gestational age cut off of spontaneous preterm birth.

To summarise, sooner in gestation, the short cervix was detected, higher is the risk of spontaneous preterm birth, with best predictive value when cervical length measurement was found to be less than 25 mm.

Several reports demonstrated beyond 30 weeks of gestational age, assessment of cervical length in prediction of preterm labour is not useful regardless of timing of delivery.

Sonography of uterine cervix:

Sonographic visualisation and appropriate measurement of uterine cervix facilitate diagnosis and management of women at increased risk for preterm birth.

Normal Cervix:

Sonographically, cervix is appreciated as a distinct soft tissue structure containing midrange echoes [16]. The appearance of endocervical canal is that of a echogenic line surrounded by hypoechoic zone which is due to endocervical glands.Occasionally endocervical canal may appear hypoechoic and minimally dilated along its entire length.

Cervical length has been evaluated by numerous studies. Due to elaboration of glandular content of cervix. the typical cervix increases its length in first trimester.

Gramellini et al put forth a reference curve of cervical length throughout gestation in both nulliparous and multiparous patients using

TVS. At about 20 weeks, at fetal anatomic survey 10^{th}, 50^{th} and 90^{th} percentile of cervical length are 40, 47 and 53 mm respectively, regardless of parity. A progressive linear reduction in cervical length occurs over 10^{th} to 40^{th} week of gestation. [5,6,17]

For scanning cervix, there are 3 approaches

1. Trans abdominal
2. Trans perineal / Translabial
3. Transvaginal

There are advantages & limitations for each approach in various clinical situations.

1.TRANSABDOMINAL APPROACH:

This examination requires a full urinary bladder to create an acoustic window, longitudinal scanning is initiated in midline of lower abdomen, just above symphysis pubis using transducer frequency of 3 MHZ (or) higher. Slight adjustment of transducer may be necessary to visualize the entire canal from internal os to external os.(fig 1)

Disadvantages:

- Full bladder falsely elongates cervix and thus cervical length measurement is affected by over distension of urinary bladder
- There may be technical difficulty in identifying external os and this may lead to error in cervical length measurement.
- Cervix less than 2 cm cannot be easily visualized against vaginal and bladder tissue.
- In obese women and when fetal head is engaged, there will be difficulty in visualization of cervix.
- There is high inter and intraobserver variation in TAS measurement of cervix.

To conclude, TAS measurement of cervix should not be used for assessment of cervix as a screening test because its sensitivity is unacceptably low (8%)

2. TRANSPERINEAL / TRANSLABIAL APPROACH:

Transperineal sonography is useful in patients for whom cervix cannot be visualized by TAS or if vaginismus prevents transvaginal approach. [16,17]

With patient in supine position, hips abducted and with empty bladder, gloved transducer is placed between labia minora at vaginal introitus.Ultrasound beam is oriented in sagittal plane along direction of vagina.Full length of cervix can be visualised in 86% to 96% of patients with this technique.

Disadvantages:

- Rectal gas (or) pubic symphysis obscures region of external os
- Mastering the technique is more difficult.
- There will be poor reproducibility of measurement.

As such, transperineal approach is not used for measuring cervical length in patients at increased risk of preterm birth.

3. TRANSVAGINAL SONOGRAPHY:

Transvaginal sonography of cervix is the reference standard technique for accurate determination of dimensions and characteristics of cervix.[16,17,35]

The examination is performed with empty urinary bladder with patient supine and hips abducted, endovaginal transducer is placed in vagina and oriented in longitudinal plane. The probe is inserted until cervix comes into view usually, transducer is inserted only 3-4 cm into

vagina to avoid contact with cervix within effective focal range of transducer. Depending on position of cervix in vagina, probe needs to be moved anteriorly, posteriorly (or) laterally.

To ensure measurement of cervical length is reproducible, the following standardized criteria have been developed.(fig2)

1. The entire echogenic cervical canal should be seen.
2. Internal os should be flat (or) should have v shaped notch.
3. External os should have a dimple or triangular area of echogenicity.
4. The area from anterior lip to cervical canal should be equidistant from posterior lip to cervical canal.
5. When cervical canal is observed to be curved, measurement can be done in two straight lines and sum of this is used to represent the total cervical length.
6. The distance between internal and external os should be measured over a minimum of 3 minutes with an average of three measurements and shortest best measurement is recorded in millimeter.

When the above steps are followed inter observer difference is less than 1.24 mm (Burger et al)

First a satisfactory image of cervix is obtained, then probe is withdrawn till blurring of image occurs and finally adequate pressure is reapplied to restore the images. This repositioning of transducer avoids error of falsely elongating cervix with too much pressure of probe on cervix anteriorly. When cervix appears curved, cervical length should be measured as a sum of individual measurement rather than a line of best fit, which underestimates full length by 3 mm if cervix is longer than 25 mm.

Transvaginal technique is obviously superior to other two techniques. Higher frequency transducer and closer proximity to structures studied allows for better resolution.

ACCEPTABILITY AND SAFETY

Transvaginal ultrasonographic appearance of cervix is safe and acceptable to antenatal women. Severe discomfort and pain are experienced by less than 1% of women. 99% of women would agree to similar procedure in the future.

RELIABILITY AND REPRODUCIBILITY

When strict adherence to standard technique is followed, interobserver and intraobserver variability is minimal and ensures reliability and reproducibility.

RECOGNISABLE EARLY ASYMPTOMATIC PHASE

Further there is a recognisable early asymptomatic phase, embracing spectrum of changes in cervix which includes initial opening of internal os, progressive shortening of cervical length ,gradual widening of endocervical canal from internal os to external os.

VALIDITY AND COMPARISON WITH DIGITAL EXAMINATION OF CERVIX

When transvaginal examination of cervix was compared with digital examination, sonographic measurement of cervix has stronger correlation with preterm birth than manual examination. Sonographic estimate of cervical length are 11 mm longer than manual estimation. Digital examination is subjective, nonspecific, inaccurate for evaluating internal os. Most of asymptomatic women with funneling of internal os will have closed cervix on digital examination.This depicts the superiority of transvaginal sonographic estimation of cervical length over digital examination.

Limitations and pitfalls:

Although TVS of cervix is usually straight forward technique, in 25 % of cases there can be technical difficulty in proper measurement of cervical length.

- **Full bladder:**

This may exert pressure on cervix and mask funneling or opening of internal os.

- **Excess pressure**

When examiner exerts more pressure which results in elongation of cervix, can result in masking of funneling (or) opening of internal os. This can be recognised by excessive echogenicity of cervix.

- **Contraction:**

Funneling of internal os can be mimicked by uterine segment contraction. In such cases, uterine contraction may appear to merge with cervix and normal cervix can be detected distal to contraction. When USG is repeated a few hours later, this demerit can be obviated.

Potential complication of TVS include induction of uterine activity in women with cervical shortening caused by cervical stimulation and chorioamnionitis in presence of ruptured membranes.

The exact mechanism by which length of cervix leads to risk of preterm labour is not fully established. Cervical length to some extent represents mechanical resistance of cervix to delivery and influences immune competence to the ascent of micro organisms offered by cervical mucus plug.

Many sonographic cervical parameters besides cervical length has been evaluated in asymptomatic high risk women in prediction of preterm birth. There is an inverse relationship between cervical length and likelihood ratio of preterm labour.

Funnel length is portion of cervix which is open and funnel width is defined as opening of internal cervical os, as detected by ultrasound. In one fourth of high risk women and a minor proportion of low risk women, internal os is found to open in second trimester.

Percent funneling is defined as proportion of funnel length in relation to total cervical length, which is obtained by addition of functional length and funnel length.

Dr. Iams et al showed funneling of internal portion of cervix occurs along a continuum, which is as follows, [18]

- T- normal closed cervix

- Y –partial effacement from internal os and this shape indicates small funnel and if it is less than one fourth of total cervical length, it is not a clinically important finding.
- V –further progression of effacement and funnel length. As it becomes close to external os, it is an important sonographic finding.
- U-membranes exposed through internal os into vagina and this shape is highly representative of preterm birth.

In the presence of funneling cervical length is less than 25 mm. Risk of preterm birth is found to be higher in instances in which both short cervical length and funneling is detected as opposed to short cervical length alone.

In contrast, if normal cervical length of 25 mm is present additional finding of funneling does not increase risk of preterm birth. Guzman et al, found, among high risk pregnancies, cervical length alone was equal to other sonographic cervical parameters for prediction of preterm labour.[41]

Change in appearance of cervix in response to transfundal (or) suprapubic pressure was proposed as a method of evaluating cervical competence in high risk cases.

Many other parameters have been studied in TVS as factors to predict preterm labour and this includes length of funnel ,width of

funnel, Widening of endocervical canal, width of anterior, posterior surface of cervix, position, angle, cervical index, endocervical gland area, vascularity.

Berghella et al showed (2008) all these parameters except for cervical length are not reliable or predictive of preterm labour. Interventions has been based on presence of short cervical length and not on percent funneling.[17]

Three dimensional ultrasound can be used to assess cervical length. Length and funneling is discernible in all three planes. Funneling can be identified only on one plane other than 2D sagittal plane. Berghella (2008) showed despite these advantages, 3D ultrasound is not necessary in clinical practice to assess cervical length.

Funnel appearance describes dilation of internal os creating appearance of funnel. In presence of internal os dilation, percentage funneling is more accurate than functional length of cervix.

However, in a large study by To et al, presence of funneling did not significantly improve accuracy beyond cervical length measurement alone in preterm labour prediction. [41]

Best gestational Age and frequency of examinations

Cervical length in first and early second trimester was normal in most of all patients including patients with high risk factors.[9]

When evaluation of cervical length was done between 10-14 weeks in high risk women, only a meagre proportion of them had cervical length less than 25mm. Sensitivity for prediction of preterm birth is low in this time interval because

- Women who have an inherent ability to deliver preterm are detected to have cervical shortening mostly around 16 weeks.
- True cervix cannot be distinguished from lower uterine segment in first and early second trimester.

Cervical length shortening after 30 weeks may not represent increased risk of preterm labour because

- There is progressive shortening of cervical length in preparation for parturition at term after this period.
- When cervical length is less than 25 mm, particularly 15-24 mm, it is considered to be physiologic after 30 week.

Short cervical length after 30 weeks has not been found to increase risk of preterm birth in asymptomatic women.

Progressive decline in cervical length or funneling is observed between 18-22 weeks. Hence if cervical length measurement is to be performed once, it is better to do it in this gestational age.

In patients who have inherent ability to deliver preterm , cervical changes are observed to occur at an earlier gestational age. When short cervical length is detected at an earlier gestational age, risk of preterm birth becomes proportionately increased in these group of women. Hence women with high risk factors for preterm labour will benefit from ultrasound examination done at an earlier gestational age, as early as 14 to 18 weeks so as to plan further intervention.

The necessity for repeat USG examination and gestational age at which it has to be repeated needs to be ascertained, but no consensus has been reached. When normal sonographic CL is observed at 14 to 18 weeks, another between 18 and 22 weeks, it is reassuring in most high risk women. But in women with highest risk of preterm birth (Patients with classical histories of cervical incompetence, prior second trimester losses or early preterm birth) it is better to do early (i.e.14-18 weeks) ultrasound which may provide guidance regarding need for intervention.

Frequency of cervical length measurement

The natural history of Cervical shortening in women who will deliver preterm may be used to determine when serial measurements should be performed.[9]

The timing of next measurement of cervical length depends on the following factors

- Cervical length measured at first visit,
- The threshold for intervention,
- Rate of decline in cervical length based on population studies.

Based on these parameters for example, if measured cervical length is 38mm, threshold for intervention is 24mm, even if cervix dilates at the maximum rate of 8 mm/week, reassessment of cervical length can be done after 2 weeks.

The rate of decrease in cervical length in those destined to deliver preterm, as derived from various studies vary from 1 to 8 mm per week and fall within 95% Confidence Interval of inter observer and intra observer variability. Hence a lapse of minimum two weeks is necessary to repeat the measurement. When frequency of measurements is done at a minimum interval, it is difficult to decipher whether the change in

cervical length is due to observational error or to real decline in cervical length.

Consensus has not yet been reached on best timing or frequency of serial measurement of cervical length. If repeat measurements are performed, they should be done at suitable intervals to minimise likelihood of error.

(Evidence level II-2).[9]

The pathophysiologic mechanisms which are involved in association of short cervix with preterm birth:

Three main mechanisms have been ascribed to contribute to development of short cervical length.[16,17]

1.INTRINSIC WEAKNESS OF CERVIX

The attractive concept that is proposed include short cervical length is caused by intrinsic weakness of cervix (or) cervical insufficiency. This cervical insufficiency is ascribed to

- traumatic or surgical damage to cervix
- rarely a congenital disorder or a connective tissue disease.

Antenatal women at high risk in most circumstances will not have short cervix in first trimester. This is because growing gestational sac will exert pressure that is inadequate to open up even the weakest of cervix in early gestation.[34]

2. INFLAMMATION

Another hypothesis is that a short cervical length is due to inflammatory or infectious process. When interleukin-6 levels are elevated in amniotic fluid, choriomnionitis and pathologic changes of placenta can occur and may culminate in short cervix. It is indeed difficult to conclude short cervical length is a consequence of infection or infection allows organisms from vagina to ascend cervical canal resulting in decline in cervical length. Whatever may be the pathway the end result is short cervix provides access of pathologic vaginal organisms into uterine cavity, leading to prolonged subclinical chorioamnionitis resulting in preterm birth.

3. UTERINE CONTRACTION

Contractions has been observed in asymptomatic women with decline in cervical length in early gestation when compared with controls with normal cervix. It is ambiguous to decide whether contractions

culminate in decline in cervical length or they are consequence of short cervix or it may be that both factors may work in synergy.

The above said mechanism along with other yet unidentified factors act in concert and contribute to the development of short cervical length.

Transvaginal sonographic cervical length assessement in asymptomatic women with history of spontaneous preterm birth.

When asymptomatic women at low risk are compared with women at increased risk, such as those with past history of spontaneous preterm birth, preterm birth is best predicted by cervical length in the latter group.

When women with history of preterm birth were studied cervical length of 25-30 mm had 80% sensitivity, 55% positive predictive value 89-90% negative predictive value in preterm labour detection.

Cervical length more than 30 mm is reassuring and 90% of these women will deliver at term. Interventions such as antibiotics, tocolytics steroids can be evaded in these women.

Cervical length and spontaneous preterm birth in high risk women

Study	Gestational age at testing	Cervical length cut off (mm)	Sensitivity	Specificity	PPV	NPV
Adhikari et al [1] Prior preterm birth	24-28	< 25mm	75	80	71	90
Owen et al Singleton prior preterm birth [18]	16-24 (Single test)	< 25mm	69	80	55	88
Crane & Hutchen et al[1]	193	< 30mm	63	77	28	93

Adhikari et al, investigated risk of prediction of preterm birth by measurement of cervical length and cervico vaginal HCG in asymptomatic women with past history of preterm birth and had found moderately high sensitivity and specificity, good negative predictive value and they concluded cervical length was superior in predicting preterm birth in comparison with cervico vaginal HCG.

JMG Crane et al [1], made a meta analysis of studies evaluating TVS measurement of cervical length in asymptomatic women with past history of preterm labour. In their evaluation of these women, cervical length less than 25 mm at an earlier gestational age predicted preterm

birth with fairly high sensitivity, 77 % specificity, low positive predictive value and high negative predictive value .

JMG Crane et al [30], made a study to determine the impact of progressive cervical shortening in asymptomatic women with past history of preterm labour by TVS and found it adds value to previously detected short cervix .

Bittar RE et al [24], evaluated validity of cervical length measurement in combination with phosphorylated insulin like growth factor binding protein in asymptomatic women with past history of preterm birth and found in women with cervical length less than 20 mm, risk of preterm delivery is increased sixfold.

Athena souka et al, evaluated from first to second trimester, of pregnancy alterations in cervical length and found cervical shortening was evident in women with past history of preterm birth. [26]

Chen ling et al [29] studied cervical length in women with past history of preterm birth and found high negative predictive value and sensitivity in predicting preterm labour.

Maiabrik et al made a comparison between cervical length and cervical inflammatory marker interleukin-6 and found it adds further value in addition to TVS measurement of short cervical length.[27]

When normal cervical length is detected between 18 and 22 week in women with past history of preterm birth which has a high negative predictive value implying most of them will deliver at term and to some extent this can avoid anxiety provoking interventions in these women.

The sensitivity of Transvaginal ultrasound measurement of cervical length to detect which high risk women will deliver preterm is 60%, much higher when compared with low risk women.

Transvaginal Sonographic cervical length assessment in other asymptomatic women at high risk

Transvaginal assessment of cervical length has been found to be valuable in predicting preterm birth in other high risk groups, including those with mullerian anomalies, prior dilatation and evacuation procedures, those with past history of excisional treatment for cervical intraepithelial neoplasia.

TVS assessment of cervical length is helpful in identifying risk of preterm birth at less than 24 wks in asymptomatic women with other risk factors for preterm birth. Evidence in favour of interventions such as cerclage, in these women is inadequate. (II-2)

Author	GA studied (mm)	CL (mm)	Sensitivity	Specificity	Positive Predictive value	Negative Predictive Value
Low risk (cross sectional) Iams Singleton [17]	22-25	25	37	92	18	97
Singleton; Mullerian anomaly Airoldi [3]	14-24	<25	71	91	50	96
Singleton ; Prior D & E Visintine [4]	14-24	<25	53	75	48	22

Visintine [4] et al, in their retrospective study of women with more than one miscarriage, found that women with multiple induced abortion and cervical length less than 25 mm have three times increased chance of preterm birth compared to women with normal cervical length . Women with a singleton pregnancy and a history of more than one miscarriage were followed by assessment of cervical length between 14 and 24 weeks with TVS and when cervix measured less than 25 mm it was deemed short. Around half of women with short cervix went in for preterm labour. Negative predictive value was high and they concluded in women with past history of more than one miscarriage, sonographic assessment of cervical length less than 25 mm was effective in predicting preterm birth.

Airoldi and associates[3] studied 64 women with a variety of uterine anomalies and measured cervical length by sonography and found it was reasonably accurate in predicting preterm birth in these women. They observed high specificity, fairly accurate positive predictive value and high negative predictive value.

Ramaeker et al [21] evaluated the contribution of vaginal bleeding and cervical length in assessment of risk of preterm labour. They found a significant correlation between cervical length and preterm birth in these women. (p value<0.001) They studied midtrimester transvaginal cervical length in women with history of first trimester vaginal bleeding and found they were at increased risk of preterm labour (odds ratio 1.5). Adjusted odds ratio for threatened miscarriage and preterm labour was 4.8 and assessment of cervical length was helpful in predicting preterm labour in these women.

Robert Romero and colleagues [28] made a systematic review and meta analysis of use progesterone in asymptomatic women with short cervix (less than 25mm) by TVS in midtrimester and found it resulted in reduction in risk of preterm birth less than 33 week and had an impact on reducing neonatal morbidity and mortality and sequelae.

Christannah M. Domin et al [31] made a systematic review of 957 abstracts, 234 articles, and 23 studies and concluded in asymptomatic

women with singleton gestation TVS measurement of cervical length was effective in prediction of preterm birth.

Since there is ample evidence of the role of 17 hydroxy progesterone caproate in prevention of preterm birth, this screening tool will have an impact in identifying patients who will benefit from this intervention.[38]

Kansaria et al [7] studied women with past history of second trimester abortion, first trimester abortion and those with past history of prior preterm labour and observed a significant correlation between cervical length and occurrence of preterm labour in these women.

Joan Crane and colleagues[1,39] made a systematic review of fourteen articles which evaluated transvaginal ultrasonographic measurement of cervical length in predicting preterm labour in asymptomatic women at high risk for preterm labour, such as past history of preterm birth, prior dilatation and evacuation, mullerian anomalies and singleton gestation .They concluded cervical length measured by TVS predicted spontaneous preterm birth in these women when a threshold of less than 25 mm was considered .Shorter the cervical length, higher was the likelihood of preterm labour in these women.

MATERIALS AND METHODS

This is a prospective study to determine correlation between cervical length measured by transvaginal ultrasonography and period of gestation at delivery, in high risk asymptomatic women.

Inclusion criteria

Multigravida registering before 16 weeks of gestation with known LMP with high risk factors such as

Previous two first trimester abortions,

Previous second trimester abortion,

Past history of preterm birth are included.

Primigravida with history of threatened miscarriage registering before 16 completed weeks of gestation are included.

Interpregnancy interval less than one and a half years or more than 5 years, evidence of infection such as periodontal disease, urinary tract infection are noted.

Exclusion criteria:

1. Multiple gestation
2. Fetal anomaly
3. Polyhydramnios
4. Induced preterm birth (e.g) severe preeclampsia, Gestational diabetes, Fetal growth restriction.

1. High risk asymptomatic antenatal women registering with known LMP are included.
2. They are explained the procedure and consent for Transvaginal sonography is obtained.
3. Measurement of cervical length with TVS is done. This is done at 16-20 wks and they are called for follow up after 3-4 weeks. If cervical length is found to be more than 25 mm at 16 -20 weeks and 20-24 weeks, further follow up scan is not done. If it is less than 25 mm, patient is called for follow up scan at 3-4 week interval until 28 weeks.
4. They are followed up until delivery.

Technique:

Mind Ray 2D Ultrasound with Transvaginal probe (Frequency 7.5 MHZ)

Position- dorsal position

Prerequisites:

Consent for TVS, after explaining procedure, empty bladder.

Technique of measurement of cervical length:

1. Patient is placed in dorsal position
2. Patient or sonographer introduces transvaginal probe covered by lubricated condom.
3. Sagittal image of cervix is obtained, transducer is slowly removed, until image begins to blur.
4. Transducer is reinserted until image is clear.
5. Cervix should occupy 50-75% of screen
6. Cervix is measured from internal os to external os and cervical canal is visualized as echogenic line surrounded by hypo echoic area.(Fig 3)

7. If cervix is not straight, two end to end straight measurements must be obtained to measure accurate cervical length.

8. Cervical canal must be equidistant from anterior and posterior cervical wall.

9. 3 measurements are obtained over a period of 3 minutes and shortest best is taken in millimeters.

In each case, the following protocol is followed.

1. History in detail, including, menstrual cycles, regularity, last menstrual period EDD calculated using Naegele's rule.
2. High risk factors for preterm labour such as past history of preterm delivery, prior first, second trimester abortion, threatened miscarriage are noted
3. History of past medical, surgical illness and other relevant history elicited.
4. Weight, height charting, BMI measurement done.
5. Routine investigations such as Hemoglobin, urine albumin, sugar, Blood grouping, Rh typing, HIV serology, GCT done.
6. General examination, per abdomen examination of each patient done.

7. Transvaginal ultrasonographic cervical length is measured at 16-18 weeks and patient called for repeat scan at 20-22 week. If cervical length is less than 25 mm, they are called for follow up scan after 4 weeks.
8. They are questioned and educated about symptoms of preterm labour such as, dull low back ache, menstrual like pain, abdominal cramp with increased vaginal discharge, sensation of heaviness in vagina etc.

They are followed up until delivery. Gestational age at delivery, birth weight of baby, NICU admissions are noted.

RESULTS

This is a prospective observational study done in antenatal women with singleton gestation with high risk factors for preterm labour from August 2011 to September 2012.

Number of women enrolled in study: 130

Among 130 antenatal women, 51 women had history of prior first trimester abortion induced or spontaneous of which 17 had other risk factors for preterm labour such as prior spontaneous preterm labour, second trimester abortion, periodontal disease, urinary tract infection, interpregnancy interval less than one and a half year or more than 5 years.

13 women had history of prior spontaneous or induced second trimester abortion, 46 women had history of prior spontaneous preterm birth. 22 women had history of threatened miscarriage with coexisting risk factors such as periodontal disease, urinary tract infection.

46 women had history of prior preterm delivery of which 11 had associated risk factors such as inter pregnancy interval more than 5 years, first or second trimester miscarriage.(table 11 & 12).3 women had mullerian anomalies(2 bicornuate,1 unicornuate uterus),out of whom two delivered preterm.

Primigravida comprise 20% of study population(n-26)whereas multigravida comprise 80% of study population.(table 2)

Total number of patients who delivered preterm were 62 which comprise 47.7 % of study group.

Total number of patients who delivered at term were 68 which comprise 52.3% of study population.(table 1)

63.7 % of women had short cervical length, rest of whom had cervical length more than 25 mm.(table 4)Rate of decline in cervical length was 0.47 mm/week.

Sensitivity of cervical length with a cut off of less than 25 mm in predicting preterm labour was 70.9% and specificity was 63.2%.

Among 69 women with short cervical length, 44 had preterm delivery which implies a positive predictive value of 63.7%. 43 women delivered at term amongst 61 women with cervical length more than 25 mm, implying negative predictive value of 70.5% (table 5)

In women with BMI less than 20, occurrence of preterm birth was highest (80%). Among the study group, 44.3 % of women with BMI 20 to 25 had preterm delivery and preterm delivery was not observed in women with BMI more than 30.

Among the study group, occurrence of preterm labour was more in women with age group less than 20 years,followed by women in age

group 20-24 years among which the occurrence of preterm labour was 52%.

When mode of delivery is considered, 82% of women delivered by labour natural. 6% had instrumental delivery, 3% had assisted breech delivery and 9% were delivered by caesarean section. 63% of preterm babies were admitted in NICU compared to 4.4 % of term babies. 50.7 % of babies born among the study group were of low birth weight. p value of transvaginal cervical length measurement in predicting preterm labour in high risk asymptomatic women with singleton gestation was 0.001, which is significant.

Table – 1

Gestational Age at delivery among study group

Gestational age at delivery	No.of cases	Percentage
Preterm (GA < 37 wks)	62	47.7
Term (GA > 37 wks)	68	52.3
Total	130	100

This table shows the distribution of term and preterm delivery among the antenatal women under study.Among the study group followed up, 47.7 % had preterm delivery and 52.3% delivered at term.

Table -2

Distribution of Parity & Incidence of Preterm labour

Parity	Preterm	Term	Total
Primi	16	10	26
Multi	46	58	104
Total	62	68	130

Primigravida comprise 20% of study group (n-26) of which 61.5% had preterm birth.Among the multiparous women constituting 80% of study group(n-104)44% delivered before 37 weeks.

Table -3

Distribution of Age and relation to Preterm labour

Age in years	No.of cases	Preterm Labour (<37 wks)
< 20	3	3
20 – 24	71	37
25 – 29	47	19
30 – 34	8	3
≥ 35	1	0
Total	130	62

Among the study group, occurrence of preterm labour was more in women in age group less than 20 years,followed by women in age group 20-24 years among which the occurrence of preterm labour was 52%.

Table -4

Correlation of Cervical Length with gestational age at delivery

Cervical length in mm	No.of cases	Preterm Labour (<37 wks)
< 25	69	44
26 – 30	10	5
31 – 35	7	1
36 – 40	39	10
> 40	5	2
Total	130	62

63.7 % of women with short cervical length (less than 25 mm) had preterm delivery.29.5 % of women with cervical length more than 25 mm had preterm delivery.

Table – 5

Cervical Length and correlation with Preterm and Term labour

Cervical length in mm	Preterm delivery(<37 wks)	Term Delivery (>37 wks)
< 25 mm (69)	44 (a)	25 (b)
> 25 mm (61)	18 (c)	43 (d)
Total	62	68

Sensitivity of short cervical length in prediction of preterm labour = 70.9%

Specificity of short cervical length in prediction of preterm labour = 63.2 %

- Positive predictive value of the test = 63.7 %
- Negative predictive value of the test = 70.5 %
- Percentage of false positive = 36.2%
- Percentage of false negative = 29.0%

'p' value < 0.001 Significant

Table – 6

Correlation of Cervical Length with Gestational age at delivery

	Cervical Length (mm)	Gestational Age (weeks)
Mean	29.45	36.15
S.D	6.77	2.45
'p' value	< 0.001 Significant	

p value of transvaginal cervical length measurement in predicting preterm labour in high risk asymptomatic women with singleton gestation was 0.001, which is significant.

Table 7

Relationship between BMI and Preterm Birth

BMI	No.of women	Preterm birth	Term delivery
< 20	10	8	2
20 – 25	106	47	59
25 – 30	13	7	6
> 30	1	0	1
Total	130	62	68

In women with BMI less than 20, occurrence of preterm birth was highest (80%) Among the study group,44.3 % of women with BMI 20 to 25 had preterm delivery and preterm delivery was not observed in women with BMI more than 30.

Table – 8

Mode of Delivery

Mode of delivery	No.of cases
Labour Natural	107
Assisted Breech delivery	4
Outlet	8
LSCS	11
Total	130

When mode of delivery is considered ,82% of women delivered by labour natural. 6% had instrumental delivery, 3% had assisted breech delivery and 9% were delivered by caesarean section

Table – 9

Distribution of Birth weight and NICU admission in study group

Birth Weight in kgs	No.of cases	NICU admission
< 1.5	5	5
1.5 - 2	29	29
2 – 2.5	32	5
2.5 – 3	39	0
3 – 3.5	21	1
3.5 – 4.0	2	0
> 4	2	2
Total	130	42

63 % of preterm babies were admitted in NICU compared to 4.4 % of term babies.50.7 % of babies born among the study group were of low birth weight.

Table 10

Distribution of women as per High Risk factors, Mean Cervical Length & Preterm Labour

Risk factors	No.of cases	Mean Cervical Length	Cervical length<25 mm	Preterm Labour (<37wks)
More than two I trimester abortion(spontaneous/induced)	34	31.02	14	6
I trimester abortion,Periodontal disease	4	31.25	2	1
I trimester abortion,UTI	2	32	1	0
I trimester abortion,inter pregnancy interval>5 years	1	36	0	0
I, II trimester abortion	10	29.2	5	2
II trimester abortion	3	28	1	0
Prior one spontaneous preterm birth	35	28.14	22	16
Prior one spontaneous preterm birth,I trimester abortion	9	24.4	7	5
Prior two spontaneous preterm birth,I trimester abortion	1	23	1	1

Prior one spontaneous preterm birth, Interpregnancy interval more than 5 years	1	38	0	0
Prior one spontaneous preterm delivery, Mullerian anomaly	1	24	1	1
Threatened miscarriage	4	28.25	2	1
Threatened miscarriage, Periodontal disease	17	29.35	10	9
Threatened miscarriage, UTI	5	34.8	1	1
Mullerian anomaly	2	37	0	0

61 women had history of prior first trimester abortion induced, spontaneous of which 17 had other risk factors for preterm labour such as prior spontaneous preterm labour, second trimester abortion, periodontal disease, urinary tract infection, interpregnancy interval less than one and a half years or more than 5 years.

13 women had history of prior spontaneous or induced second trimester abortion, 46 women had history of prior spontaneous preterm birth. 22 women had history of threatened miscarriage with coexisting risk factors such as periodontal disease, urinary tract infection.

46 women had history of prior preterm delivery of which 11 had associated risk factors such as inter pregnancy interval more than 5 years, first or second trimester miscarriage.

Among women with prior induced or spontaneous abortion (n=51), 30 women had short cervical length, of which 50% of women had preterm delivery.

In 46 women with history of spontaneous preterm labour studied 65% (n=30) had short cervix. 73% of women who had short cervix with history of previous preterm birth had recurrent preterm birth.

20% of women had (n-26) threatened miscarriage along with other risk factor such as periodontal disease and urinary tract infection, 50% of these women had cervical length less than 25mm, out of which 86% had preterm birth.

DISCUSSION

In our study, among women, with prior induced or spontaneous abortion (n=51), 30 women had short cervical length, of which 50% of women had preterm delivery.

Visintine et al[4], analysed transvaginally measured cervical length in women with singleton pregnancy and more than one prior induced abortion. The sensitivity of short cervix (Cervical length <25 mm) in prediction of preterm labour was 50% and specificity was 85% . Women with multiple induced abortions and short cervical length have 3 times increased risk of preterm labour compared to women with cervical length more than 25 mm. Berghella et al studied prospectively, women with more than two dilatation and curettage for termination of pregnancy and found similar results.

Crane, Hutchens et al[1] concluded, from their study of transvaginal sonography in prediction of preterm labour in women with history of preterm birth, that they had increased risk of recurrent spontaneous preterm birth and this is predicted by short cervical length (<30mm)

Comparison of present study with other studies

Author	N	Preterm birth	GA Studied	Cervical length cut off	Sensitivity	Specificity	PPV	NPV
Singleton prior preterm birth, Owen [18]	183	26	16-24	25	64	78	30	94
Singleton: prior D&E, Visintine [4]	131	30	14-24	25	53	75	48	78
Singleton:Mullerian anomaly, Airoldi [3]	64	11	14-24	25	71	91	50	96
Present study: singleton, prior preterm birth, prior D&E, Threatened miscarriage, mullerian anomaly	130	62	16-26	25	70.9	63.2	63.7	70.5

Bittar, Fonseca et al [24] evaluated efficacy of cervical length in predicting preterm delivery in women with history of preterm birth. Women with short cervical length(< 20 mm) had 69% risk of spontaneous preterm delivery.

In our study, 46 women with history of spontaneous preterm labour were studied of which 65% (n=30) had short cervix. 73% of women who

had short cervix with history of previous preterm birth had recurrent preterm birth.

Women with threatened miscarriage are at increased risk of preterm delivery. Devon Rameker [21] et al, evaluated contribution of vaginal bleeding and cervical length to risk of preterm labour and found after accounting for cervical length and interaction, the adjusted odds ratio for vaginal bleeding and preterm birth was 4.8. In present study, 20% of women had (n-26) threatened abortion along with other risk factor such as periodontal disease and urinary tract infection, 50% of these women had cervical length less than 25mm, out of which 86% had preterm birth.

In high risk asymptomatic women with singleton gestation, transvaginal measurement of cervical length with cut off of 25mm has 71% sensitivity (present study) in predicting preterm labour (<37 weeks) Sensitivity of cervical length less than 25 mm in predicting preterm birth in women with prior preterm birth was 69% (Owen et al) and in women with prior miscarriage,the sensitivity was 53% (Vistintine et al)

Specificity of short cervical length in predicting preterm labour in present study was 63.2%, which was comparable to that obtained by other authors.

Negative predictive value was 70.5% which implies 70% women who had cervical length more than 25mm delivered at term, in present study. Negative predictive value was 88% (owen, et al) and 78% (Visintine, et al) in preterm labour prediction in other studies.

63.7% of high risk asymptomatic women who had short cervical length, delivered at less than 37 weeks gestation which implies a positive predictive value of 63.7 % which was comparable to 55% (Owen et al) and 48% (Visintine et al)

Spontaneous preterm birth increases as length of cervix declines more so with gestational age at which shortening of cervical length detected decreases.

In asymptomatic women with singleton pregnancy with high risk factor for preterm labour, transvaginal ultrasonographic measurement of cervical length is predictive of preterm labour.

SUMMARY

130 antenatal women with singleton gestation with high risk factors for preterm labour were enrolled in the study.Primigravida comprise 20% of study group, rest being constituted by mutigravid women. Major proportion of antenatal women in study population were in age group 20-24 years.

Among the study group,35.3 % (n-46) had history of prior spontaneous preterm birth.11 women had associated risk factors for preterm labour such as spontaneous or induced first trimester abortion, interpregnancy interval more than 5 years, mullerian anomaly.

46.9% of study population had history of two or more first trimester abortion, either spontaneous or induced and 27 women had co existing risk factors such as second trimester abortion,(n-10)prior one spontaneous preterm birth,interpregnancy interval more than 59 months,evidence of infection such as periodontal disease and urinary tract infection. 20 % of women among study group had history of threatened miscarriage.

53% of women had sonographic estimation of cervical length less than 25 mm. 46.9% of women had cervical length more than 25 mm. 63.7% of women with short cervix had preterm delivery.

When mode of delivery is considered, 82% of women delivered by labour natural. 6% had instrumental delivery, 3% had assisted breech delivery and 9% were delivered by caesarean section. 50.7 % of babies were of low birth weight.(n-66).63% of preterm babies had NICU admission compared to 4.4 % of term babies.

Among the study group, occurrence of preterm birth was more in women with BMI less than 20 followed by women with BMI 20 -25 among whom the incidence of preterm birth was 44.3 %.

Antenatal women in age group less than 20 had highest occurrence of preterm delivery, followed by women in age group 20-24 years who had 52 % preterm birth.

The sensitivity and specificity of cervical length estimated by transvaginal sonography was 70.9% and 63.2% respectively in prediction of preterm birth in women at high risk for preterm labour.

Regarding the validity of test , positive predictive value was 63.7 % in prediction of preterm labour in women with high risk factors.70.9% of women with cervical length more than 25 mm had term delivery,i.e,negative predictive value of the test was 70.5%.

Hence, transvaginal sonographic estimation of cervical length has a fairly accurate sensitivity and specificity in prediction of preterm labour in women with high risk factors such as prior spontaneous preterm birth,

prior first trimester, second trimester miscarriage, threatened miscarriage. Validity of test as reinforced by good negative predictive value suggests that it can be used as a screening test in prediction of preterm birth in women with singleton gestation and having high risk factor for preterm labour.

CONCLUSION

Preterm delivery has significant contribution to perinatal mortality, infant death and morbidity ranging from cerebral palsy to chronic lung disease. Prediction and prevention is imperative than control. Medical, educational loss, economic cost, social burden on individual and families necessitate reduction in preterm birth.

Numerous biomarkers are under research of which few are under vogue.Their efficacy, cut off value need to be standardized by further studies.Transvaginal sonographic determination of cervical length in women with singleton pregnancy and high risk for preterm labour is a useful screening tool for prediction of preterm labour.

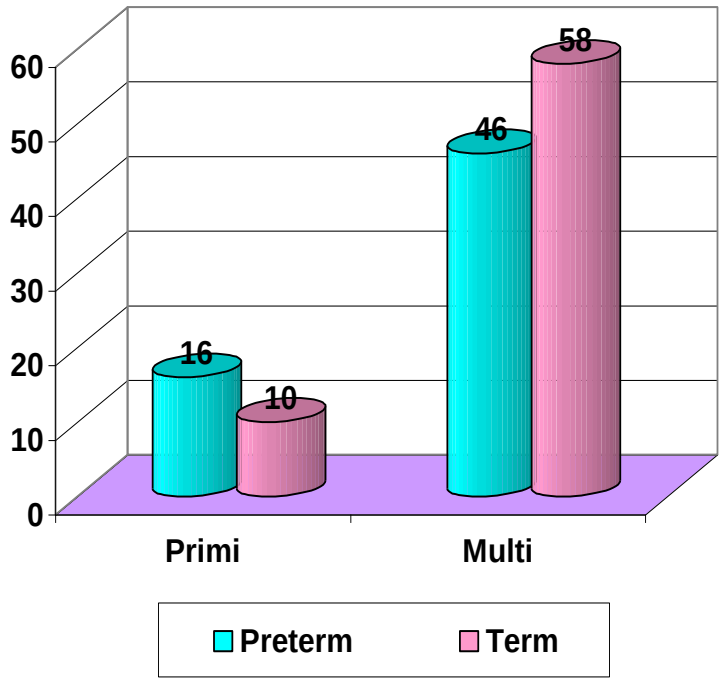
Recent studies including those by Fonseca et al ,have shown the efficacy of progesterone in reducing preterm labour in women with past history of preterm birth, to which sonographic short cervix adds value by proper selection of cases.

Compared to biomarkers, transvaginal sonographic cervical length measurement is

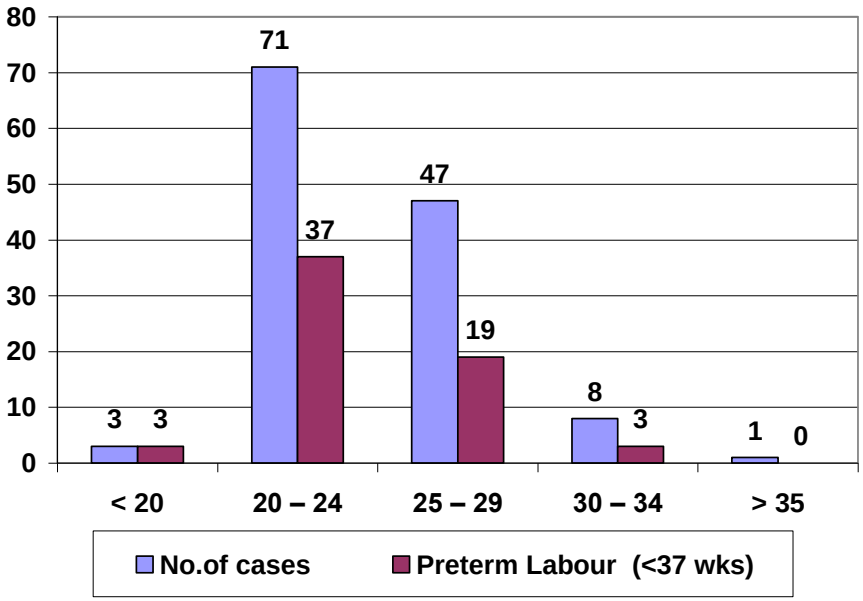
- less expensive,
- easily accessible,
- objective,
- reproducible

- acceptable to the patient and
- can be combined with routine anomaly scan in women with risk factors for preterm labour.

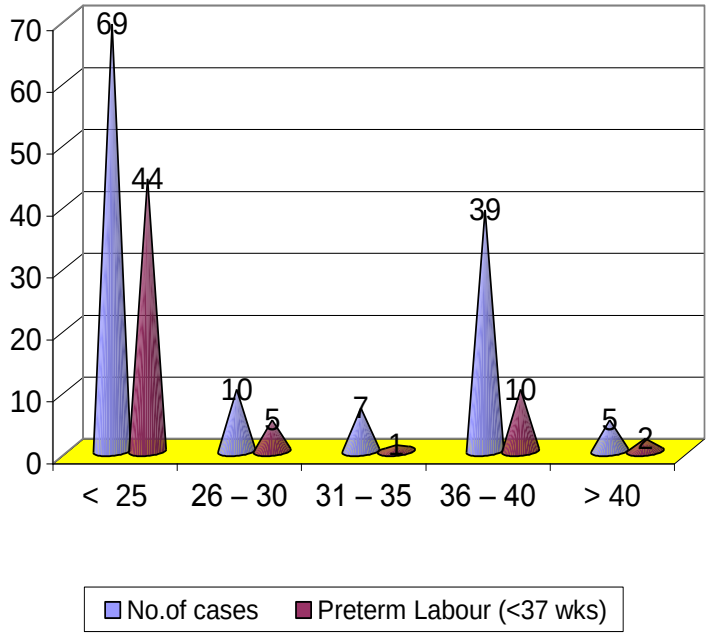
PARITY AND DISTRIBUTION OF PRETERM LABOUR



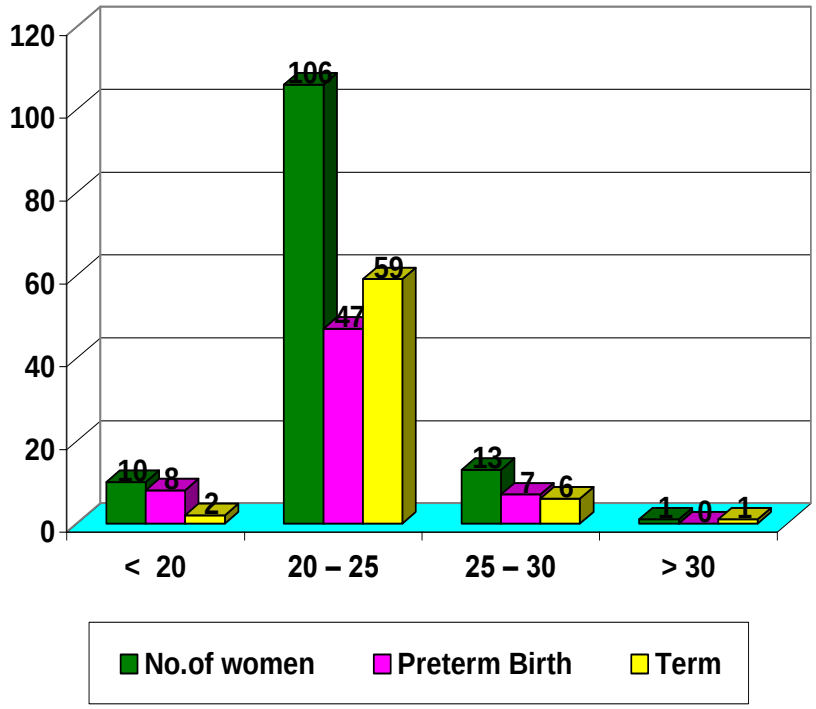
DISTRIBUTION OF AGE IN YEARS VS PRETERM LABOUR



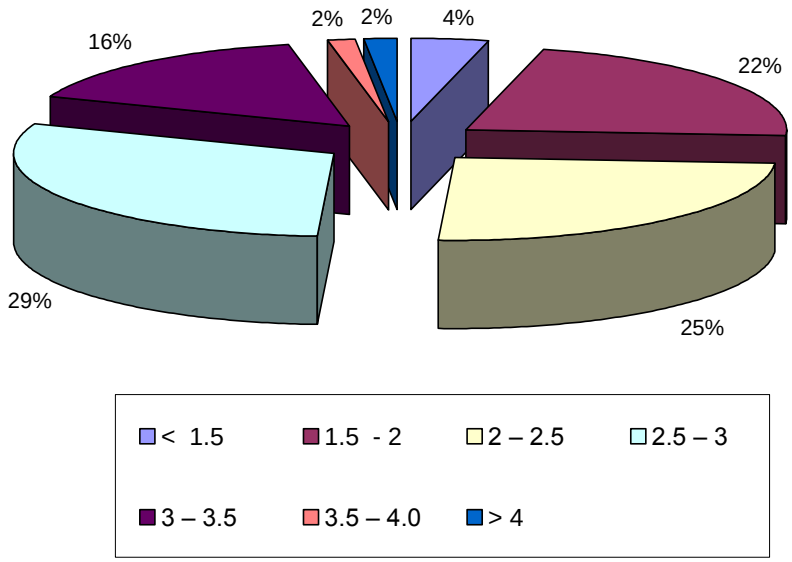
DISTRIBUTION OF CERVICAL LENGTH (MM) WITH GESTATIONAL AGE AT DELIVERY



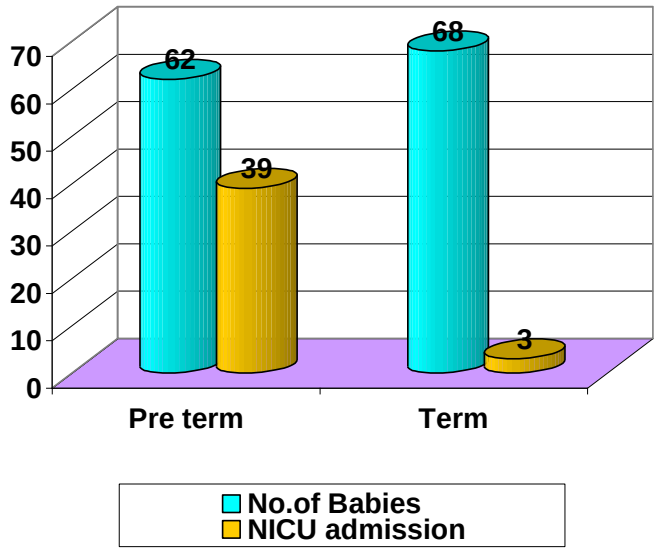
BMI WISE DISTRIBUTION OF TERM AND PRETERM LABOUR

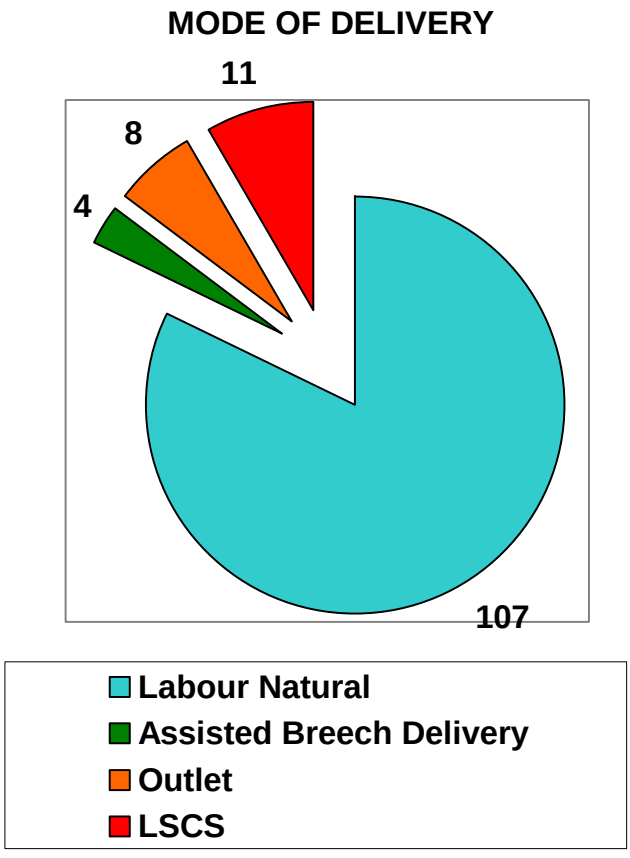


DISTRIBUTION OF BIRTH WEIGHT (IN KG) AMONG STUDY GROUP



NICU ADMISSION




MODE OF DELIVERY
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4
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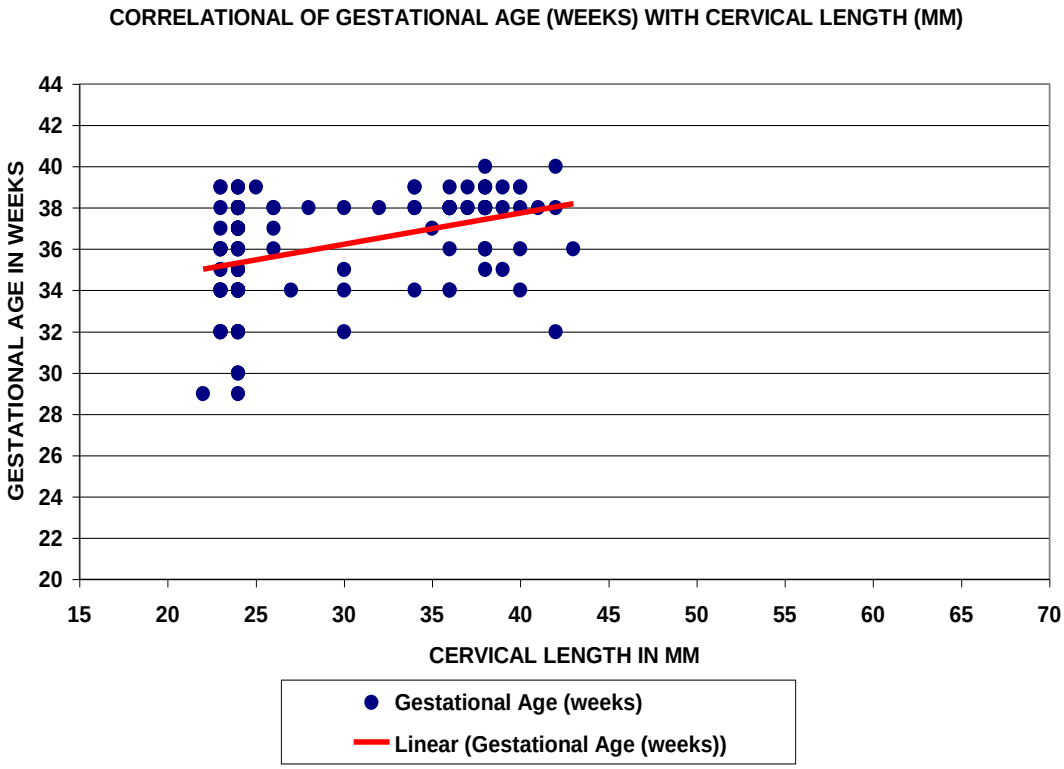
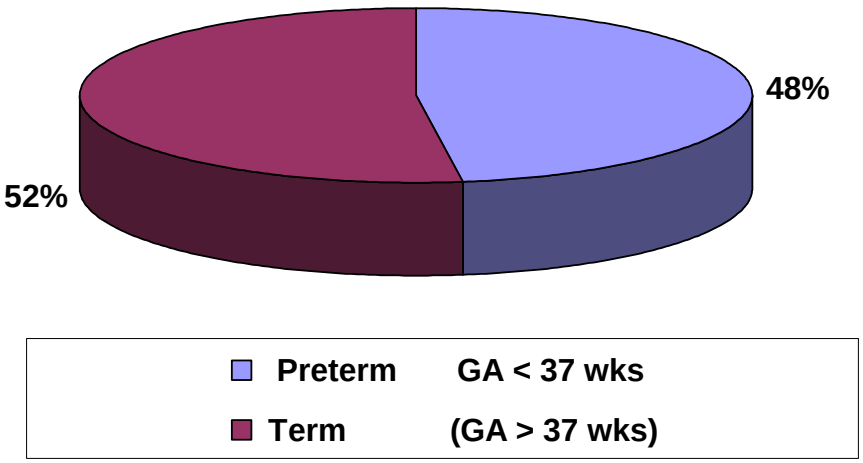
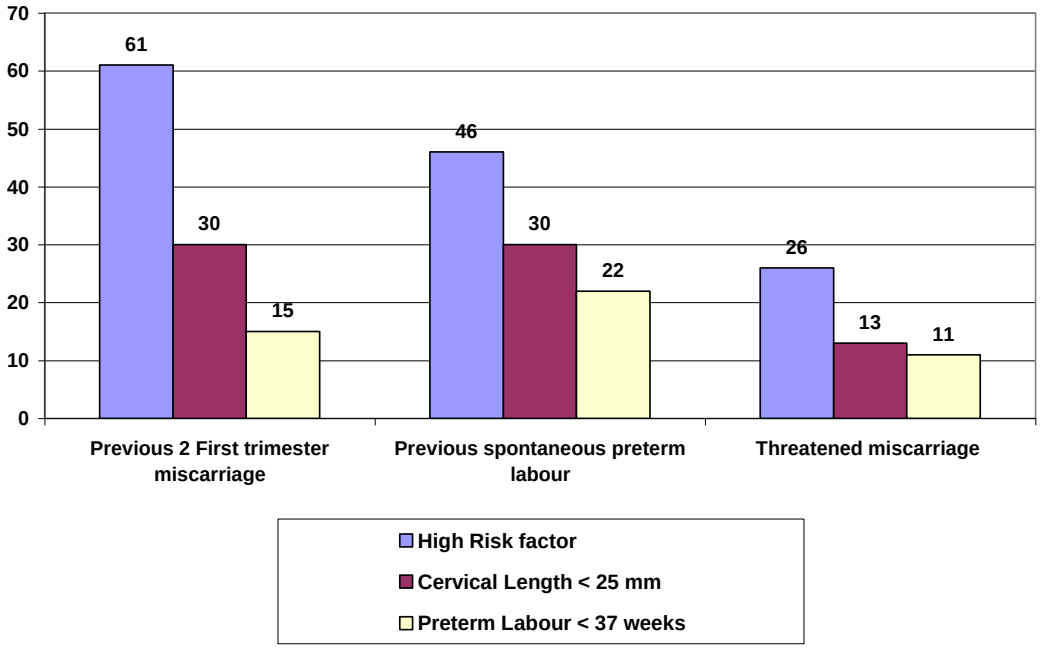
Labour Natural
Assisted Breech Delivery
Outlet
LSCS

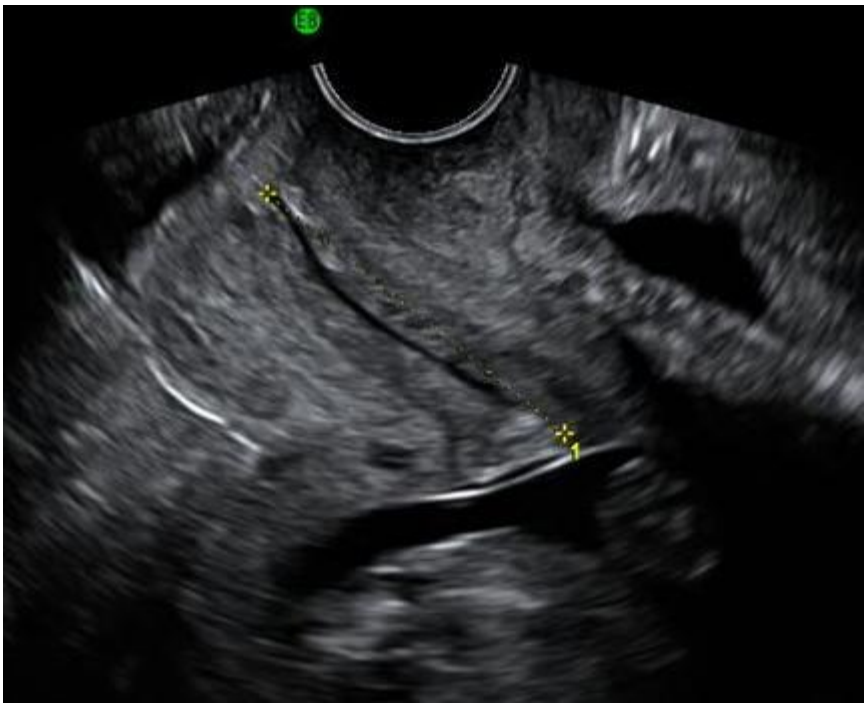

CORRELATIONAL OF GESTATIONAL AGE (WEEKS) WITH CERVICAL LENGTH (MM)
GESTATIONAL AGE IN WEEKS
44
42
40
38
36
34
32
30
28
26
24
22
20
15
20
25
30
35
40
45
50
55
60
65
70
CERVICAL LENGTH IN MM
Gestational Age (weeks)
Linear (Gestational Age (weeks))

DISTRIBUTION OF PRETERM AND TERM LABOUR AMONG STUDY GROUP

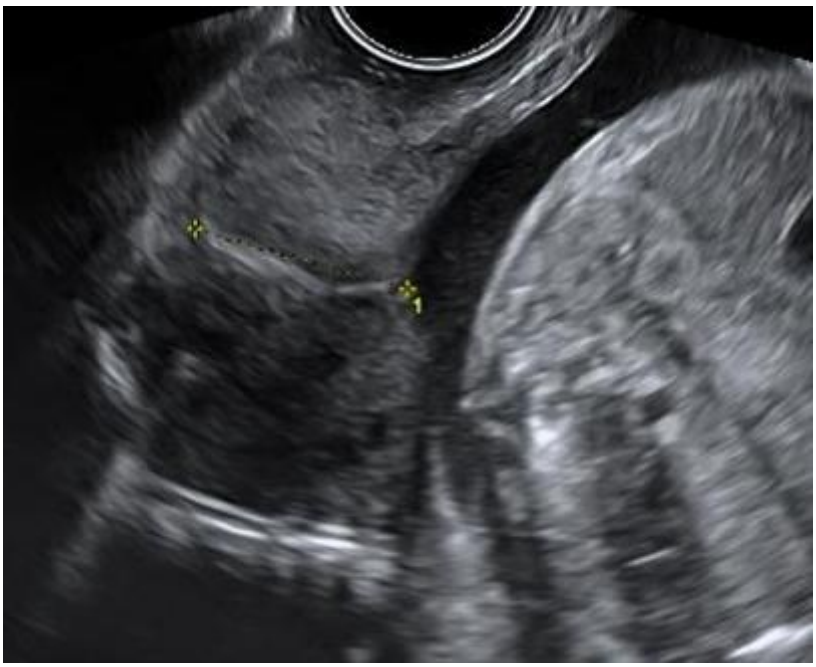


DISTRIBUTION OF CERVICAL LENGTH AND PRETERM LABOUR AS PER HIGH RISK FACTORS

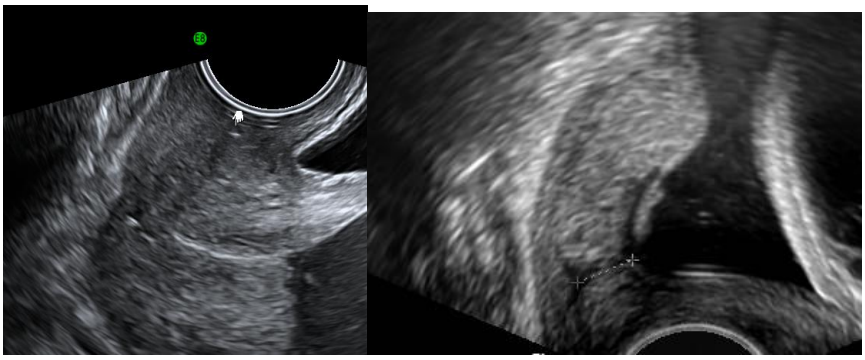




NORMAL CERVICAL LENGTH(40 MM)

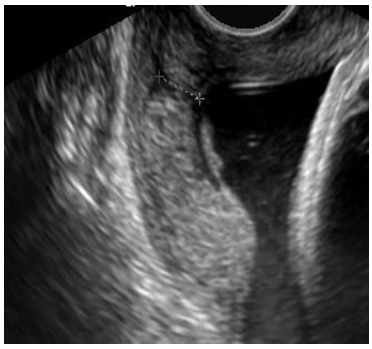


SHORT CERVIX (CERVICAL LENGTH 24 MM)

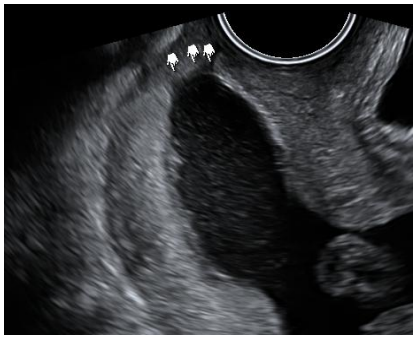


T Y

TVS SHOWING CONTINUUM OF CHANGES (T,Y,V,U)



V



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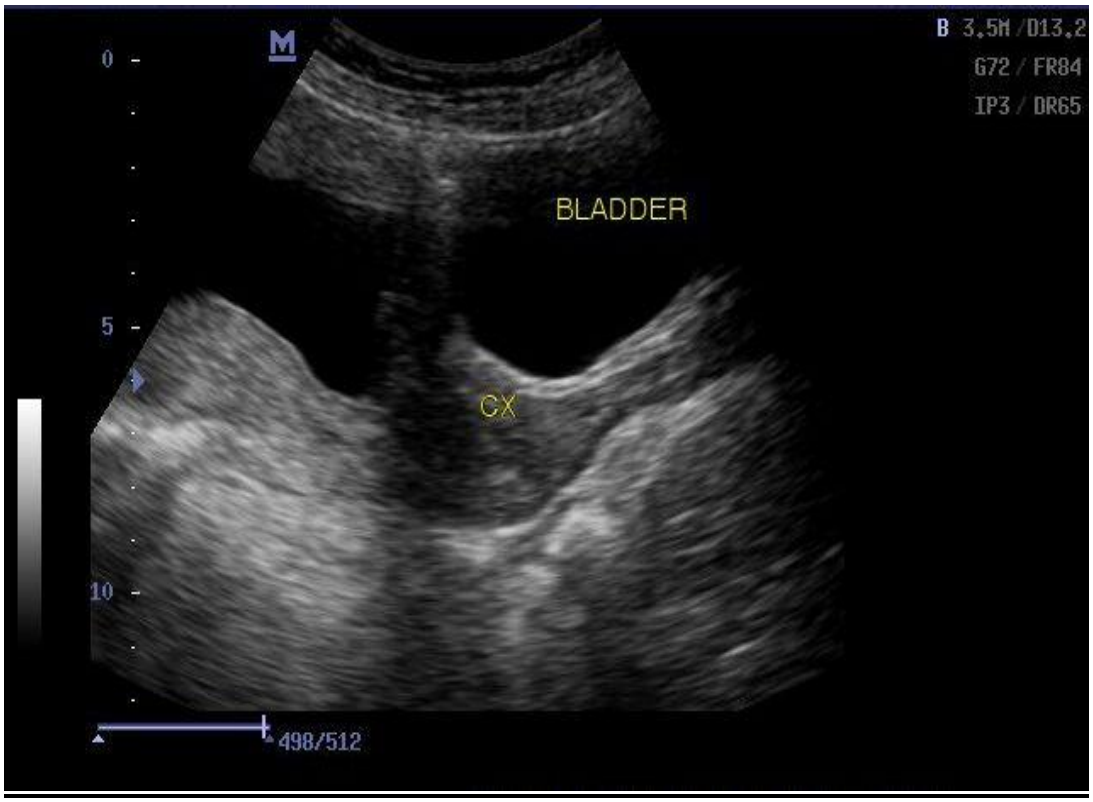

Fig 1 Transabdominal scan of cervix

Fig ,Transvaginal sonography of cervix.

Fig3, Transvaginal sonography of cervix showing cervical length measurement

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PROFORMA

TRANSVAGINAL ULTRASONOGRAPHIC ASSESSMENT OF CERVICAL LENGTH IN PRETERM LABOUR PREDICTION IN HIGH RISK ASYMPTOMATIC WOMEN WITH SINGLETON GESTATION IN GRH MADURAI

NAME: AGE : RELIGION;

EDUCATION : OCCUPATION:

ADDRESS :

CONTACT NUMBER :

OP NO: IP NO; UNIT:

HISTORY OF PRESENTING ILLNESS:

MENSTRUAL HISTORY :

Cycles regular / irregular

LMP EDD;

MARITAL HISTORY:

OBSTETRIC HISTORY;

Primi / Multi

History of abortion: Induced or Spontaneous

GA at abortion

History of previous preterm birth

GA at delivery

Interval between pregnancy

PRESENT PREGNANCY:

Spontaneous or Conception after ART

History of threatened miscarriage

PAST HISTORY:

History of uterine anomalies/ treatment taken for CIN

Other medical surgical illness

FAMILY HISTORY:

Presence of medical and surgical illnesses

PERSONAL HISTORY:

Diet, stress, passive smoking

GENERAL EXAMINATION;

Build; nourishment;

Anemia, edema legs, cyanosis, clubbing,
Icterus, Lymphadenopathy, Periodontal disease

Height, Weight , BMI

PR BP:

CVS RS:

P/A:

PV

INVESTIGATIONS:

Hb

Urine : Albumin. Sugar deposit,

Urine culture and sensitivity

PPTCT

BLOOD GROUP

GCT

ULTRASOUND:

TRANSABDOMINAL SONOGRAPHY :

Single Presentation: GA:

Placenta

Liquor:

Anomalies:

Uterine anomalies

TRANSVAGINAL SONOGRAPHY:

Cervical length ;

FOLLOW UP SCAN ;

TREATMENT;

FOLLOW UP:

Mode of delivery

GA at delivery

B.W

APGAR: 1’ 5’

HIGH RISK FACTORS

1 - Prior spontaneous or induced first trimester abortion.

2 - Prior spontaneous or induced second trimester abortion.

3A - Previous one spontaneous preterm birth.

3B - Previous two or more spontaneous preterm birth.

4 - Threatened miscarriage.

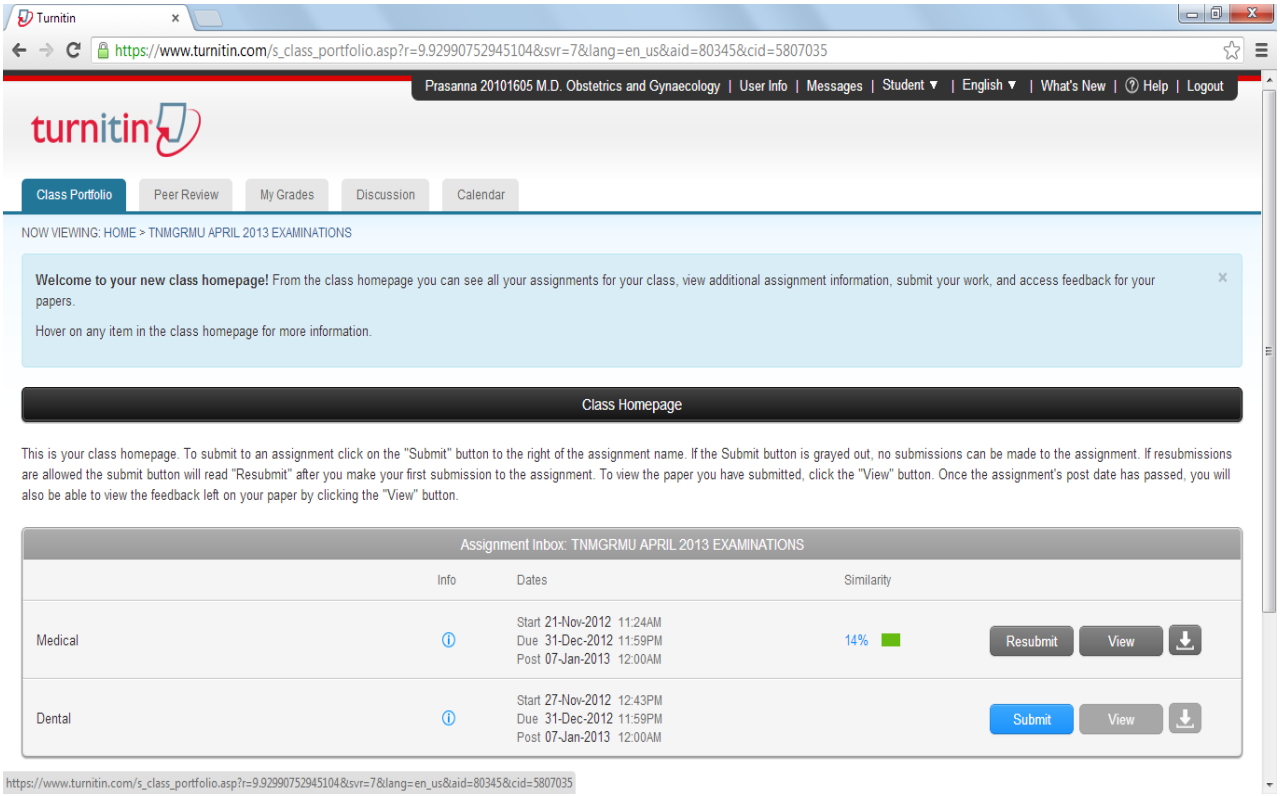
5A - Interpregnancy interval more than one and half years.

5B - Interpregnancy interval less than five years.

6A - Periodontal disease

6B - Urinary tract infection.

7 - Mullerian anomaly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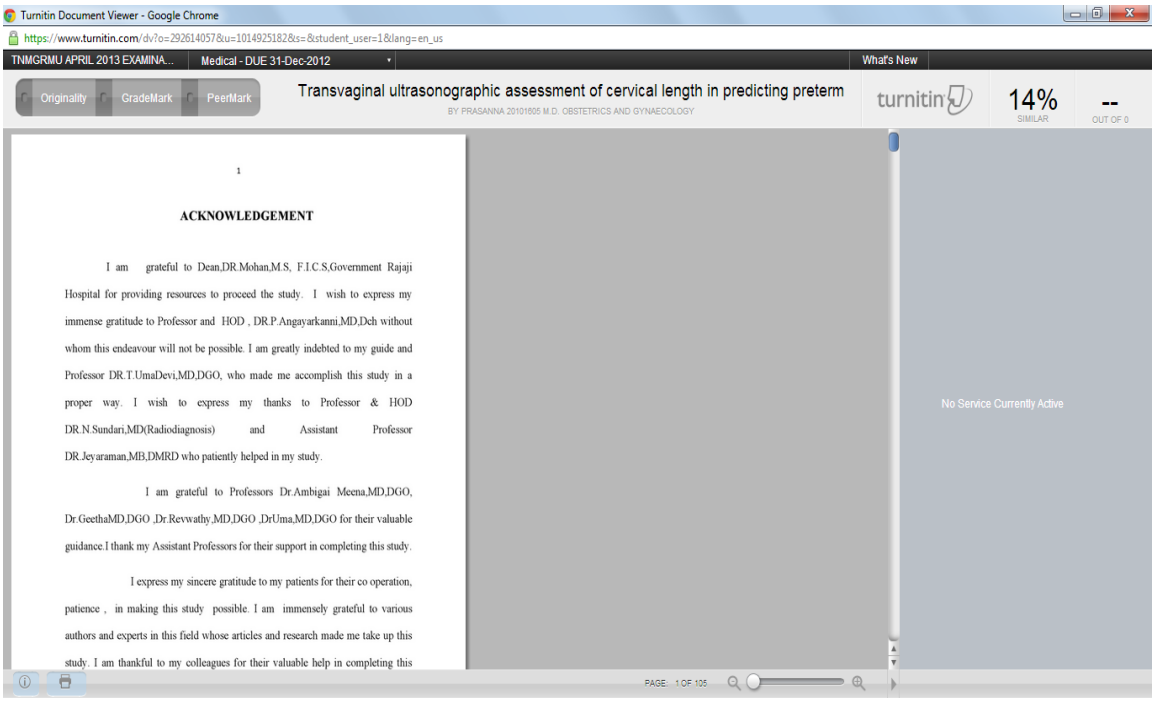
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ACKNOWLEDGEMENT
I am grateful to Dean,DR.Mohan,M.S, F.I.C.S,Government Rajaji Hospital for providing resources to proceed the study. I wish to express my immense gratitude to Professor and HOD , DR.P.Angayarkanni,MD,Dch without whom this endeavour will not be possible. I am greatly indebted to my guide and Professor DR.T.UmaDevi,MD,DGO, who made me accomplish this study in a proper way. I wish to express my thanks to Professor & HOD DR.N.Sundari,MD(Radiodiagnosis) and Assistant Professor DR.Jeyaraman,MB,DMRD who patiently helped in my study.
I am grateful to Professors Dr.Ambigai Meena,MD,DGO, Dr.GeethaMD,DGO ,Dr.Revwathy,MD,DGO ,DrUma,MD,DGO for their valuable guidance.I thank my Assistant Professors for their support in completing this study.
I express my sincere gratitude to my patients for their co operation, patience , in making this study possible. I am immensely grateful to various authors and experts in this field whose articles and research made me take up this study. I am thankful to my colleagues for their valuable help in completing this
No Service Currently Active
PAGE 1 OF 105

21/3/2012

Ref. No. 3104/E4/3/2012 **Govt.Rajaji Hospital,Madurai.20.**
Dated: 29.03.2012

Institutional Review Board / Independent Ethics Committee.
Dr. A. Edwin Joe, M.D (FM), BL.,
Dean, Madurai Medical College & 2521021 (Secy)
Govt Rajaji Hospital, Madurai 625020.
Convenor
grhethicssecy @gmail.com.

Sub: Establishment-Govt. Rajaji Hospital, aMadurai-20-
Ethics committee-Meeting Agenda-communicated-regarding.

The Ethics Committee meeting of the Govt. Rajaji Hospital, Madurai was held at 11.00 Am to 1.00Pm on 29.03.2012 at the Dean Chamber, Govt. Rajaji Hospital, Madurai. The following members of the committee have been attended the meeting.

1. Dr.N.Vijayasankaran,M.ch(Uro.) 094-430-58793 0452-2584397	Sr.Consultant Urologist Madurai Kidney Centre, Sivagangai Road,Madurai	Chairman
2. Dr.P.K. Muthu Kumarasamy, M.D., 9843050911	Professor & H.O.D of Medical, Oncology(Retired)	Member Secretary
3. Dr.T.Meena,MD 094-437-74875	Professor of Physiology, Madurai Medical College	Member
4. Dr. S. Thamilarasi, M.D (Pharmacol)	Professor of pharmacology	
5. Dr.Moses K.Daniel MD(Gen.Medicine) 098-421-56066	Professor of Medicine Madurai Medical College	Member
6. Dr.M.Gobinath,MS(Gen.Surgery)	Professor of Surgery Madurai Medical College	Member
7. Dr.S. Dilshadh, MD(O&G) 9894053516	Professor of OP&Gyn Madurai Medical College	Member
8. Dr.S.Vadivel Murugan., M.D, 097-871-50040	Professor of Medicine Madurai Medical College	Member
9. Shri.M.Sridher,B.sc.B.L. 099-949-07400	Advocate, 2, Deputy collectors colony 4th street KK Nagar, Madurai-20.	Member
10. Shri.O.B.D.Bharat,B.sc., 094-437-14162	Businessman Plot No.588, K.K.Nagar,Madurai.20.	Member
11.Shri. S.sivakumar,M.A(Social) Mphil 093-444-84990	Sociologist, Plot No.51 F.F, K.K Nagar, Madurai.	Member

Following Projects were approved by the committee

Sl. No	Name of P.G.	Course	Name of the Project	Remarks
1.	Prasanna .N	PG, M.D (ob gyn)	Ultrasound assessment of cervical length in predicting preterm labour	Approved

Please note that the investigator should adhere the following: She/He should get a detailed informed consent from the patients/participants and maintain Confidentially.

1. She/He should carry out the work without detrimental to regular activities as well as without extra expenditure to the institution to Government.
2. She/He should inform the institution Ethical Committee in case of any change of study procedure site and investigation or guide.
3. She/He should not deviate for the area of the work for which applied for Ethical clearance. She/He should inform the IEC immediately, in case of any adverse events pr Serious adverse reactions.
4. She/he should abide to the rules and regulations of the institution.
5. She/He should complete the work within the specific period and apply for if any Extension of time is required She should apply for permission again and do the work.
6. She/He should submit the summary of the work to the Ethical Committee on Completion of the work.
7. She/He should not claim any funds from the institution while doing the word or on completion.
8. She/He should understand that the members of IEC have the right to monitor the work with prior intimation.

DEAN

To
All the above members and Head of the Departments concerned.
All the Applicants.

MASTER CHART

Sl.no	Name	Age	I.P.NO	Obstetric code	BMI	High risk factors	Gestational age(weeks)	Cervical length(in mm)	Follow up scan I Gestational age (weeks)	Cervical length (in mm)	Decline in cervical length (mm/week)	Follow up scan GA (weeks) II	Cervical length (in mm)	Decline in cervical length(mm/week)	Treated for preterm labour	mode of delivery	Gestational age(weeks)	Birth weight in kg	NICU Admission
1	Amusu	25	3825	G3A2	23.8	1	18	37	22	35	0.50				NO	LSCS	39	3.5	NO
2	Padmavathy	24	3964	G6P1L1A4	22.8	1	16	38	23	35	0.43				NO	LSCS	39	2.75	NO
3	Kaleeswari	23	4230	G4 P1L1A2	21.9	1	18	38	24	36	0.33				NO	LN	38	2.8	NO
4	Saranya	19	4128	G2P1L0	21.5	3A	16	24	21	24	0.00	26	23	0.2	YES	LN	35	2.2	NO
5	Meena	28	4443	G3P1L1A1	25.5	1,3A	17	24	24	26	-0.29	28	22	1	YES	LN	35	2.2	NO
6	Nagajyothi	26	4541	G2P1L0	19.1	3A	18	24	22	23	0.25	26	22	0.25	yes	ABD	34	2.1	YES
7	Tamilarasi	23	4599	G3A2	23.7	1,6B	18	40	22	38	0.50				NO	LN	39	3.2	NO
8	Eswari	24	4541	G3P1L1A1	23.8	1,3A	18	24	22	24	0.00	26	23	0.25	YES	LN	32	1.8	YES
9	Muthulakshmi	26	4672	G2P1L0	21.5	3A	18	24	22	23	0.25	26	23	0	NO	LN	38	2.5	NO
10	Alagulakshmi	20	5024	G3A2	20.7	1	18	30	23	28	0.40				YES	LSCS	35	2.25	NO
11	Sangeetha	21	3078	G3A2	21	1,6A	18	24	22	24	0.00	26	22	0.5	NO	LN	39	2.5	NO
12	Thangamani	27	2841	G5P2L2A2	23.2	1,3A	18	24	22	24	0.00	26	22	0.5	YES	LN	34	1.6	YES
13	Selvi	23	1880	G4P1L1A2	23.7	1	17	38	24	36	0.29					LN	38	3.2	NO
14	Sulochana	25	2444	G2P1L0	22.5	3A	17	40	22	32	1.60					LN	39	2.8	NO
15	Veeralakshmi	24	2234	G4P2L0A1	20.6	1,3B	18	23	22	23	0.00	26	21	0.5	YES	LN	32	1.5	YES
16	Nagalakshmi	22	2260	G3A2	21.4	1	18	41	22	36	1.25				NO	LSCS	38	2.5	NO
17	Krishnaveni	26	2278	G4P2L1A1	22.5	1,3A	18	27	23	26	0.20				YES	ABD	34	1.5	YES
18	Sivakami	24	2819	PRIMI	24	4,6A	18	42	24	35	1.17				YES	LN	32	1.75	yes
19	Ramuthai	23	5721	G3A2	23.7	1	18	36	24	32	0.67					LN	38	2.3	NO
20	Dhanalakshmi	22	344	G3A2	19.7	1,6A	17	24	24	24	0.00	28	23	0.25	YES	LN	34	1.5	YES
21	Muthulakshmi	24	16844	G4A3	28	1	17	38	22	34	0.80	27	34	0	YES	LN	39	3	YES
22	Sathya	23	17955	G3P2L0	23	3A	18	24	22	24	0.00	26	22	0.5	YES	LN	34	2	NO
23	Prabha	30	8451	G4P1L1A2	28.3	1	18	42	23	41	0.20					LN	40	3.3	NO
24	Selvi	22	6935	G2P1L0	25.1	3A	18	24	23	24	0.00	28	22	0.4	YES	LN	32	1.75	YES
25	Sivasankari	24	25420	G3P2L0	21.9	3A	18	24	24	24	0.00	26	23	0.5	NO	LN	38	2.75	NO
26	Pandiammal	21	16784	G2P1L0	24.6	3A	18	23	24	23	0.00				YES	LN	35	2.5	NO
27	Bagyalakshmi	28	16967	G4P1L1A2	27.1	1,2	17	39	22	38	0.20				YES	LN	35	2.25	NO
28	Dhanalakshmi	20	7446	G3A2	27.3	1,2	18	24	24	26	-0.33				YES	LN	35	2.25	NO

29	Chinnaviri	23	8174	G3A2	23.7	1	18	36	22	34	0.50				YES	LN	36	2.3	NO
30	Nagajyothi	22	4167	G2P1L1	21.2	3A	18	24	24	22	0.33	28	21	0.25	YES	ABD	30	1.2	YES
31	Sundarvalli	26	19597	G3A2	27.7	1,2	18	24	23	23	0.20	26	22	0.33	YES	LN	38	2.2	NO
32	Mahalakshmi	23	19455	PRIMI	25	4,6A	18	23	22	22	0.25				YES	OUTLET	34	1.9	YES
33	Karpagavalli	28	18928	G4P1L1A1	30.7	1,5B	18	36	22	35	0.25					LN	38	3	NO
34	Poornamathy	27	18918	G4P1L1A2	28.3	1	17	24	22	23	0.20	26	23	0		LN	37	2.25	NO
35	Banumathy	32	18665	G2P1L0	28.8	3A	18	23	22	25	-0.50	26	24	-0.25	YES	LN	34	1.9	YES
36	Priya	28	19524	G3A2	23.8	1	18	38	22	36	0.50					OUTLET	38	2.25	NO
37	Pandiammal	27	19488	PRIMI	27.2	4,6A	18	24	22	23	0.25				YES	LN	34	1.8	YES
38	Surya	26	6342	G4A3	24.2	1	18	24	22	24	0.00	26	23	0.25	NO	LN	38	2.8	NO
39	Vahini	28	6697	G2P1L1	28.3	3A,5B	18	38	24	36	0.33				NO	LN	36	2.5	NO
40	Oyyamal	26	6832	G3A2	26.4	1,6A	18	39	24	34	0.83					LN	39	3.2	NO
41	Leelavathy	26	10793	G3P1L0A1	23.1	1,3A	18	24	22	24	0.00	26	22	0.5	YES	LSCS	34	2.2	YES
42	Sandya	22	9836	PRIMI	25.4	4,6A	18	38	22	36	0.50				NO	LN	40	2.75	NO
43	Eswari	29	4457	G3P1L1A1	23.7	1,6B	17	24	23	24	0.00	26	23	0.3	NO	LN	37	2.8	NO
44	Gomathi	20	4612	G2A1	19	4	17	23	23	23	0.00	26	21	0.67	YES	LN	32	1.9	YES
45	Rajalakshmi	31	4328	PRIMI	23.1	7	17	38	22	38	0.00				yes	LSCS	35	2	NO
46	Annapoorna	25	12003	G3A2	24	1	18	24	22	24	0.00				YES	LN	36	1.75	YES
47	Sarada	21	4587	PRIMI	21	4,6B	17	24	22	22	0.40	26	17	1.25	yes	LN	32	2	YES
48	Kalaiselvi	24	4549	G2P1L1	24.2	3A	17	23	24	22	0.14				YES	LN	32	1.7	YES
49	Sarasvathy	25	15998	G3A2	21.9	1,2	18	24	22	23	0.25	26	23	0	YES	LN	37	2.1	NO
50	Nandhini	21	4493	PRIMI	23.8	4,6B	18	38	22	36	0.50					LN	36	2.1	NO
51	Veeramal	21	14714	G2A1	22.5	1,6A	18	38	23	38	0.00					LN	38	3	NO
52	Kavitha	30	15050	G3A2	22.3	1,2	18	34	24	32	0.33				YES	LN	34	1.3	YES
53	Muthu	29	14228	G3P2L1	24.4	3A	18	36	24	34	0.33				YES	LN	34	1.8	YES
54	Gowri	28	14302	G3A2	20	1,2	18	24	22	21	0.75	26	21	0		LN	29	1	YES
55	Padmavathy	29	14315	G3A2	23.3	1	18	36	22	34	0.50				NO	LN	38	2.5	NO
56	Ambika	29	14334	G3P1L1A1	23.3	1,3A	18	24	22	23	0.25	26	23	0	NO	LN	39	4	YES
57	Vennila	26	14465	G2P1L1	24.4	3A	18	30	23	28	0.40				NO	LN	34	1.7	YES
58	Pavunpriya	27	14737	G2P1L1	23.4	3A	18	24	23	24	0.00	26	22	0.67	YES	LN	34	1.8	YES
59	Gomathy	38	14883	G3P2L0	21.9	3A	18	24	23	25	-0.20				NO	LN	38	2.5	NO
60	Grace Priya	24	24896	G3P2L1	23.3	3A	18	24	23	23	0.20	27	21	0.5	YES	LN	34	2.1	YES
61	Pandeeswari	24	10134	G3P2L1	22.6	3A	18	40	22	38	0.50				YES	LN	34	2	NO
62	Sonaieswari	27	13538	PRIMI	17.9	4,6A	18	37	23	35	0.40				NO	OUTLET	38	3	NO
63	Jannath Burdosh	22	12886	G3P2L1	22.6	3A	18	24	23	23	0.20	26	23	0	NO	LN	39	4	YES
64	Alageswari	23	11405	G2P1L1	20	3A	17	43	22	41	0.40				NO	LN	36	2.2	NO

65	Fathima Beevi	30	12816	PRIMI	24.2	4,6B	16	36	22	34	0.33					LSCS	38	3	NO
66	Vanmathy	27	10238	G3P1L1A1	21.8	2	18	34	23	32	0.40					LN	38	3	NO
67	Rubavathy	24	14054	G3A2	23.9	1	17	23	22	23	0.00	26	22	0.25		LN	38	3	NO
68	Suganthi	25	12555	G3P2L0	21.9	3A	18	37	22	35	0.50					LSCS	38	3.5	NO
69	Pandijyothi	24	13459	PRIMI	21.9	4,6B	18	40	22	38	0.50					LN	36	2.25	NO
70	Udayavani	24	19650	G2P1L1	22.8	3A	18	24	23	23	0.20	27	21	0.25		LN	35	2.25	NO
71	Andal	27	16281	G5P1L1A3	20.2	1	18	22	22	20	0.50	26	19	0.25	YES	LN	29	1.1	YES
72	Sumithra devi	22	4007	PRIMI	22.3	4,6A	17	36	24	33	0.43					LN	38	2.6	NO
73	Eswari	24	4451	G3P1L1A1	23.7	1,3A	18	24	22	21	0.75	26	20	0.25	YES	LN	34	1.8	YES
74	Sumathy	26	5785	G2P1L0	21.3	3A	18	24	22	24	0.00	26	23	0.25	NO	OUTLET	37	2.7	NO
75	Muthulakshmi	21	8633	PRIMI	23.3	4,6A	18	38	22	36	0.50				NO	LN	38	2.5	NO
76	Selvi	32	19677	G6P1L1A4	22.5	1	17	24	22	24	0.00	26	22	0.5		LN	38	3	NO
77	Jeyasuda	26	18722	G4A3	24	7	17	36	23	34	0.33					LN	38	3.2	NO
78	Sivanjyothi	18	23080	G2P1L0	23.4	3A	18	23	22	24	-0.25	26	24	0	YES	LN	34	1.8	YES
79	Nandhini	25	20571	G3P1L1A1	24.8	2	18	24	22	24	0.00	26	23	0.25	YES	LN	37	2.3	NO
80	Veeramal	22	21155	G4P3L1	24.3	5A	17	23	23	23	0.00	26	22	0.33		LN	36	2.5	NO
81	Prabavathi	20	2E+05	PRIMI	16.9	4,6A	18	23	23	21	0.40	27	20	0.25	YES	LN	32	1.7	yes
82	Malaiarasi	23	20123	G3P1L1A1	23	1	18	24	22	24	0.00	26	22	0.5		LN	36	2.4	NO
83	Sathyavani	23	20133	PRIMI	18.7	4,6A	18	23	24	24	0.17	26	22	0.5		LN	36	2.5	NO
84	Chinnapandi	28	22672	G2P1L1	23.1	3A	17	24	22	24	0.00	26	23	0.25	YES	LN	30	1.3	YES
85	Aishwarya devi	21	22577	G4A3	23.7	1	16	36	22	36	0.00					LSCS	38	2.3	NO
86	Priya	20	19575	PRIMI	22.5	4,6A	18	30	24	28	0.33				yes	LN	32	1.5	YES
87	Sathya	23	20224	G3A2	23.3	1	18	24	23	23	0.20	26	20	1		LN	36	2	NO
88	Kanmani	24	23133	G5P1L0A3	23.7	1,3A	18	23	22	23	0.00	26	22	0.33		LSCS	39	2.9	NO
89	Muthumari	24	20287	PRIMI	23.6	4,6A	18	24	23	23	0.20	26	22	0.33	YES	LN	34	1.6	YES
90	Ramya	21	19688	PRIMI	23.8	4,6B	18	36	22	35	0.25					LN	34	2.25	YES
91	Usha	25	20214	G3A2	21.6	1	18	39	22	38	0.25					OUTLET	38	2.7	NO
92	Gomathi	21	20033	G3A2	24	1	18	38	22	34	1.00				yes	LN	36	1.7	YES
93	Amsavalli	26	20159	G3P2L1	23.6	3A	18	23	22	24	-0.25	26	22	1		LN	36	2.7	NO
94	Mahalakshmi	20	20175	PRIMI	23.1	4,6A	18	23	22	23	0.00	26	20	1	YES	LN	34	1.9	YES
95	Karthigadevi	22	23774	G3A2	22	1	18	40	22	39	0.25					OUTLET	38	2.6	NO
96	Sithara	24	3365	G2P1L1	20	3a,7	18	24	22	24	0.00	26	23	0.25		ABD	32	1.9	YES
97	Punitha	19	20294	PRIMI	24	4,6A	18	24	22	24	0.00	26	23	0.25		LN	34	1.6	YES
98	Jeyapriya	29	20166	G5A4	21.6	1	18	24	22	24	0.00	26	23	0.25		LN	37	2.2	NO
99	Kalaiselvi	20	19744	G2P1L0	23.3	3A	17	24	22	26	-0.40	25	24	0.67		LN	36	2.6	NO
100	Karthiga devi	22	23774	G3A2	24	1	18	35	22	32	0.75					OUTLET	37	2.6	NO

101	megala	23	20506	PRIMI	21.5	4,6A	18	24	22	23	0.25	26	20	0.75	YES	LN	34	1.75	YES
102	ameena beevi	23	20625	PRIMI	23.7	4,6A	18	24	22	24	0.00	26	21	0.75	no	LN	38	2.9	NO
103	Shanthi	25	20480	G4P1L1A2	21.9	1,2	18	23	22	23	0.00				NO	LN	39	2.75	NO
104	Maruthammal	24	20693	G3P1L1A1	22.2	1,3A	18	26	22	25	0.25				NO	LN	38	3.1	NO
105	Indumathy	23	20476	G3A2	19.5	1	18	25	23	25	0.00				NO	LN	39	2.8	NO
106	Malarvizhi	32	20478	G3A2	23.7	1	18	30	22	24	1.50	26	22	0.5	NO	LN	38	2.6	NO
107	Sathya	26	20491	G3A2	22.5	1	19	23	22	23	0.00	26	22	0.25	YES	LN	34	1.75	YES
108	Karpagavalli	23	20495	G3A2	23.6	1	18	24	23	24	0.00	26	23	0.33	NO	LN	37	3	NO
109	Solaiammal	23	21249	G3A2	20.2	1	18	34	23	32	0.40				NO	OUTLET	39	3.4	NO
110	Saranya	20	21302	G3A2	23.7	1,2	18	38	22	36	0.50				NO	LN	38	3.2	NO
111	Chandrakani	22	21211	PRIMI	22.3	4	19	28	23	26	0.50				no	LN	38	2.9	NO
112	Manjula devi	24	21263	G3A2	21.4	1	18	23	22	21	0.50	26	20	0.25	YES	LN	37	2.25	NO
113	Pandiammal	25	20817	G2P1L1	22.2	3A	18	38	22	34	1.00				NO	LN	38	2.6	NO
114	Kaliammal	23	21376	G4P1L1A2	23.4	1,2	18	36	23	35	0.20				NO	LN	38	2.7	NO
115	Angaleeswari	24	21459	PRIMI	23.7	4,6A	18	42	22	38	1.00				no	LN	38	2.6	NO
116	Tamilpriya	20	21448	G3A2	24.2	1,2	18	26	23	24	0.40	26	23	0.33	NO	LN	37	2.4	NO
117	Marysangeetha	25	21400	PRIMI	24.6	4	18	24	22	23	0.25	26	22	0.33	NO	LN	38	2.75	NO
118	Muthupandi	20	20913	G3A2	21.8	1	18	23	22	24	-0.25	27	22	0.4	no	LN	36	2.5	NO
119	Ayyamal	26	22817	G3P1L1A1	23.4	2	18	26	22	24	0.50	26	22	0.5	NO	LN	36	2.5	NO
120	Dhanalakshmi	25	22898	G2P1L1	22	3A	18	24	22	22	0.50	26	21	0.25	NO	LN	37	2.4	NO
121	Rakku	23	22876	G2P1L1	23	3A	18	32	23	30	0.40				NO	LN	38	3	NO
122	Vellamal	22	22931	PRIMI	21.9	4,6A	18	24	22	21	0.75	26	20	0.25	YES	LN	34	1.7	YES
123	Shenbagavalli	26	22878	G3P2L1	23.7	3A	18	34	23	32	0.40				NO	LN	38	3.1	NO
124	Selvi	26	22853	G3A2	24.6	1	18	24	22	21	0.75	26	19	0.5	YES	LN	37	2.1	NO
125	Ayyamal	26	22922	G2P1L0	21.5	3A	18	24	23	22	0.40	27	21	0.25	YES	LN	34	1.65	YES
126	Roja	34	22706	G3P2L1	24.2	3A	18	26	22	24	0.50	26	22	0.5	NO	LN	38	2.75	NO
127	Maheswari	27	22613	G2P1L1	21.8	3A	18	36	22	34	0.50				NO	LN	38	2.6	NO
128	Chitra	24	22741	G2P1L1	23.7	3A	18	34	22	34	0.00				NO	LN	39	2.75	NO
129	Petchipriya	22	24970	G2P1L1	21	3A	18	36	22	34	0.50				NO	LN	39	3	NO
130	Muthurajam	22	26718	PRIMI	23	4	18	38	22	36	0.50				NO	LSCS	39	3	NO

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